Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. LVI. NEW YORK, THURSDAY, DECEMBER 29, 1910. No. 26.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

239 West Thirty-ninth Street, New York.

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TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico, $3.00 per year; Canada, $4.50 per year. All Other Countries, $6.00 per year. Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. Date on wrapper indicates the month at the end of which subscription expires.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday of the week of issue.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World for 1909 was 945,850. Of this issue 17,000 copies are printed.

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INTERNATIONAL ELECTRICAL CONGRESS OF TURIN.

We are informed that it is proposed to hold next year at Turin, Italy, during the week commencing Sept. 11, in conjunction with the International Exhibition of Industry and Labor at that city, an International Electrical Congress of the Applications of Electricity. A committee of organization has been formed under the auspices of the Associazione Elettrotecnica Italiana and circulars of information are commencing to be issued concerning the organization. A number of important practical questions are proposed for discussion during the convention. The importance of the convention will be enhanced by the fact that it is proposed to hold the next meeting of the International Electrotechnical Commission at Turin during the same week. It is expected that the commission will not only increase the attendance at the congress, but that there will also be some co-ordination between the two bodies.

The last International Electrical Congress was held at Marseilles in 1908, but, unfortunately, the number of electrical men other than Frenchmen attending that congress was limited, so that it was very nearly reduced to a national electrical congress. The last preceding International Electrical Congress was held at St. Louis and was attended by over 700 persons, 200 of whom were from abroad. The total number of adhesions was about 2050, of whom about 400 were from abroad. It was the more difficult to secure foreign members for the St. Louis congress because St. Louis lies at a distance of about 4000 miles from the shores of Europe. On the other hand, with a fine city like Turin for a meeting place, in the heart of beautiful Piedmont, at a pleasant season of the year, and within easy access of all parts of Europe, it should readily be possible to attract from other countries a large gathering of men interested in applied electricity, thus making the congress truly international.

We hope that in due time the American Institute of Electrical Engineers will appoint a number of delegates to the congress at large, and that the United States may be fairly represented. Of course, our distance from Turin is great and the time of year selected is late, from an American standpoint, but, on the other hand, the date selected is early from a European point of view and Americans usually regard the distance from New York to central Europe as shorter than our confrères in Europe ordinarily regard the distance from central Europe to New York. Apart from the technical and social advantages of such a congress to the members who gather there for joint discussion and meeting, there should be many incidental advantages in such a gathering. Efforts might be made to co-ordinate the work of the congress, which is a temporary and evanescent organization, with that of the commission, which is a semi-permanent organization, so that by the discussions in the congress on some of the questions under consideration by the commission the latter body might find its work lightened, its decisions hastened and its findings more universally indorsed.

MAGNETIC PROPERTIES OF IRON AND ITS ALLOYS IN INTENSE MAGNETIC FIELDS.

The systematic study of magnetism in iron and its alloys through all the range of available magnetic forces is important not only to the development of magnetic science, but also to that of applied magnetism. The magnetic properties of iron and steel are now almost as important to civilization as the structural and mechanical properties of these most useful substances. If there can exist a practically procurable substance with more powerful magnetic properties than iron it is very important to the electrical industry that such a substance should be procured and tried. Moreover, even if we are necessarily limited to the use of iron and steel in magnetic machinery, the influence of the admixture of other substances by alloying with iron is worthy of being thoroughly investigated from the practical standpoint alone. A paper on the above topic has recently been read, by Messrs. R. A. Hadfield and B Hopkinson, before the Institution of Electrical Engineers of Great Britain, covering mainly a research into the behavior of iron in intense magnetic fields, i. e., fields producing in the iron a flux density of from 5 kilogausses to 25 kilogausses, or more. The results, which are abstracted in the Digest, are of great interest from various points of view.

The broadest result obtained is that which sustains the existing theory of magnetization in iron—namely, that iron and its alloys may be regarded as saturating magnetically in a field of 5000 gilberts per centimeter, although a few alloys show incomplete saturation even in this field. Pure iron, of specific gravity 7.8, generates a saturation flux density of 21 kilogausses in such a field, and it may be considered as incapable of generating any more than this. But a total flux density of, say, 50 kilogausses can, of course, be produced in iron by subjecting it to a field of 29,000 gilberts per centimeter, which would be able to generate a flux density of 29 kilogausses in the absence of the iron. Consequently, so far as we know, there is no upper limit to the flux density that can be produced in a small sample of iron under laboratory conditions. It is, however, assumed in this thory that the high flux density produced will be 21 kilogausses over and above what can be produced in air in the absence of the small sample. The results also show that no alloy was found with a higher specific magnetism or a higher saturation flux density than pure iron, although certain alloys with a small proportion of silicon, or of aluminum, magnetically outrank pure iron in relatively feeble magnetic fields. Another very important result is that in an annealed iron-carbon steel a linear relation was found between the percentage of carbon and the saturation flux density for small proportions of carbon admixture. Similar straight-line law results were obtained with certain silicon and aluminum alloys of iron, but no such result with nickel-iron or manganese-iron alloys.

The general deduction from this interesting paper seems to be that the magnetic properties of alloys are more readily detected and collated when working with intense magnetic fields than when working with feeble or with moderate magnetic fields. The complexities that present themselves are sufficiently great when powerful fields are used, but additional complexities and differences arise when feeble fields are used. Indeed, the authors suggest that such tests of alloys may be capable of throwing light, not merely on their magnetic properties, but also on their constitution and structure. The more familiar we become by laboratory investigation and by industrial experience with the magnetic properties of iron the more wonderful and salient the latter become. We are still in ignorance as to whether the magnetism of iron is a subatomic or a molecular property. That is, we are not yet certain whether a single atom of iron is a magnet in and of itself, or whether it takes a certain grouping or assemblage of a plurality of iron atoms to develop magnetic properties. Whatever may be the fact in this ultramicroscopic field of matter, it seems clear that in iron there is a certain m.m.f. per molecule which is always capable of being evoked and oriented by the action of a superposed aligning magnetic field. When the magnetic field is absent the total m.m.f. in the mass may fall to zero; but in a powerful field the structural m.m.f. in the iron reaches a certain saturation limit and each individual molecule develops, pro rata, a certain fraction of an ampere-turn.

REPRESENTATION OF HYSTERESIS LOSSES IN IRON.

It is well known that when we subject laminated steel to alternating magnetization, as in the armature core of a dynamo machine, the iron becomes heated and power is wasted therein. A certain share of this total loss, or total waste power, takes the form of eddy-current loss, and this share can be reduced by using thinner laminations. The remainder of the loss does not admit of being reduced by further lamination and is called the hysteresis loss. If we increase the amplitude of the alternating flux density, keeping the temperature and the frequency constant, the two components of loss—the eddy and hysteresis components—increase, but not to the same extent. Ordinarily, the eddy-current loss increases as the square of the maximum cyclic flux density, while the hysteresis loss does not increase so rapidly. If the hysteresis loss increased directly with the density, doubling the density would multiply the hysteresis watts by two. If the hysteresis loss increased as the square of the density, doubling the density would multiply the hysteresis watts by four. It is found by experiment that doubling the density within the ordinary range of densities employed multiplies the hysteresis watts by three, very nearly, or midway between the effects of the first and second powers.

It was first pointed out by Dr. Steinmetz that the hysteresis loss varied as the 1.6th power of the flux density to within a satisfactory degree of precision for engineering purposes, and this rule has become generally adopted. The 1.6th power of 2 is, in fact, approximately 3.03. This rule is generally known as Steinmetz's hysteresis law. It is, however, known and admitted to be an empirical formula rather than a physical law. Discrepancies present themselves when the rule is applied rigorously. An article by Herr Rudolf Richter has recently appeared in the *Elektrotechnische Zeitschrift*, as alluded to in this week's Digest, suggesting that the curve connecting hysteresis loss and maximum cyclic flux density to rectangular co-ordinates is really a parabola instead of a curve of the 1.6th power. A parabolic relation may be defined as a relation which includes, in general, a term involving the first power, added to a term involving the second power, of the independent variable; so that the known approximate relation of trebled

hysteresis loss to doubled density is explainable as due to the summation of two terms, one involving the first power and the other the square of the density. Curves and tables derived from measurements are produced in the article to show that the parabolic relation satisfies the observations somewhat more closely than the Steinmetz rule.

The two-term parabolic equation is longer than the Steinmetz equation, and, at first sight, appears the more formidable of the two. It is pointed out, however, that the total loss in the iron requires two terms to be used in any event, so that it is merely a choice, in practice, between an equation containing the 1.6th and second powers, or one containing the first and second powers. The latter is the easier to deal with of the two, because tables of squares are nearly always available, whereas tables of 1.6th powers are uncommon and are tedious to compute. From a practical standpoint it is not a very important matter whether the law of hysteresis is parabolic or of the 1.6th power. There is abundant experience to show that the 1.6th power deals with the matter satisfactorily, so far as engineering is concerned. It is important, however, to investigate the matter more thoroughly from a physical standpoint in order to check the proposition that the parabolic rule is the more precise of the two.

ELECTRICITY IN FARMING.

An article abstracted in the Digest this week makes clear that interest has been aroused in Germany with respect to the application of electric power to farming. From the historical standpoint one would expect a greater progress in the agricultural application of electricity than has heretofore been recorded, for the very first commercial application of the electric motor was to tilling the land in the famous plowing experiments at Sermaise, now more than thirty years ago, and the next application near the same place was a motor lift for unloading beets at a sugar factory; so one may fairly say that the farmer had the first chance at electric power. If one looks for the cause of the slow development from this beginning it is easily found in the matter of cost. Until very recently electric power has been somewhat too costly to encourage its use by those who have little ready money, and farmers, save on the huge estates of some of the grain-raising belts, are only too apt to belong to this class. The small farmer in particular manages to pick up a very good living if he is industrious and thrifty, but he is not in a position usually to get electric power for the minor mechanical operations around the farm as cheaply as he can get power from gasoline engines or even by the use of horse motors.

The German paper which serves as the text of this comment bears especially on the use of electricity on farms of the larger size replacing horse-power in the various operations for which power is required, from plowing to reaping, as well as in the minor mechanical operations for which motive power is convenient. In the former case the motor can replace horses as draft animals, and in the latter case it can free them from the treadmill. Of the applicability of motors to these agricultural tasks there is no doubt. Electrical operation of farm machinery, whether fixed or movable, has already been demonstrated too many times to leave any question as to the effectiveness of the work. However, when it comes to the question of economy the situation changes, not with respect to the usefulness of electricity, but as regards the economy of mechanical power generally as contrasted with animal power. Granted the use of draft horses, which is a practical necessity in any region where the transportation facilities are not first class, full utilization of their working capacity would seem to call for their employment in all the work about the farm which they are capable of doing. A horse, considered merely as a machine, is probably considerably less efficient than an electric motor, but the farmer can feed the horse off the products of the soil directly and largely off products which might otherwise go to waste, while he must feed the motor from the receipts derived from his selected farm products passed through several intermediaries over expensive lines of transportation. At this point the horse, although a somewhat wasteful means for the transformation of energy, makes a good showing of economy, since he is his own middleman and transportation system. On the other hand, in the case of very large farms where the work can be pretty thoroughly differentiated, there is much to be said for the suggestions of our German contemporary. Working on a scale big enough to enable one, so to speak, to divide the output of energy upon the farm into transportation and stationary motor departments, the latter can, if elecric supply is available, be accomplished through electric power with both convenience and efficiency, and in the former department the automobile has already made inroads upon the laborious prerogatives of the horse. In our own country the National Electric Light Association has appointed a committee to look into this question of the applications of electricity to farming, and from the investigation there should appear at least a modest number of cases in which electric power would be extremely well worth trying.

We have, however, in our own country very large areas of agricultural country in which electric power is not readily obtained. To be sure, the electric transmission systems are of immense extent, but of late there has been so strong a tendency toward the wholesaling of power rather than its distribution to the ordinary consumer as to decrease somewhat the usefulness of electrical transmission from the standpoint of the casual user along the lines. It requires a fairly complete network of distribution to furnish convenient and adequate supply of energy over a large and scattered farming territory. Intensive farming, such as is carried on in parts of the Continent, is scarcely known on this side of the Atlantic, and it is only in intensive farming or in farming on a large scale that the motive power department, so to speak, can conveniently be separated from the rest of the work. Granted intensive farming on a considerable scale, the farm would naturally become a user of power large enough to justify a general distribution for power purposes over a territory almost strictly agricultural; but that, we fear, is a matter for the future and perhaps a rather distant future. At our present rate of increase of population the United States, which has already lost the characteristic economic features of frontier life, must ere long come to the point where, in order to supply its own wants without inordinate expense for transportation, it must undertake intensive agriculture under scientific conditions. When this time comes electricity on the farm will become a practical issue rather than an attractive theory.

Railroad Terminal Electrification Agitation in Chicago.

Sometimes quiescent but never totally extinct, the agitation for the electrification of the terminals of the steam railroads in Chicago has been conducted for a number of years. The latest chapter in the story is revealed by a letter from Mr. H. A. Stillwell, the president of the Association of Commerce, to the Mayor and Common Council, made public at the meeting of the City Council on Dec. 19. As announced in the *Electrical World* of Feb. 3, 1910, the Association of Commerce, which is a powerful and influential organization of business men, has been conducting an investigation into the subject, and this study has already covered a period of eighteen months. The work is in charge of a special committee of the association, and Mr. Stillwell writes to the city authorities to say that a point has been reached where it seems necessary to go into the practical or business side of the question, involving, among other things, the element of cost. It appears that the committee of the association has finished its work in relation to the feasibility of electrification from an engineering point of view and it now desires to co-operate with the city in relation to the economic problems involved. Mr. Stillwell asked the Mayor to name four persons to represent the city in making the remaining investigations, and, with the concurrence of the City Council, Mayor Busse named Alderman Milton J. Foreman, chairman of the local transportation committee; Dr. W. A. Evans, commissioner of health; Paul P. Bird, chief smoke inspector, and T. E. Donnelley, president of the Chicago Smoke-Abatement Commission, as the city's representatives to assist in making the inquiry requested by the Association of Commerce.

The Association of Commerce is making an impartial study of the subject and its strong committee consists of Mr. John M. Ewen, engineer and contractor, chairman; Bion J. Arnold, consulting engineer; Mr. A. Bement, consulting engineer; Mr. Paul P. Bird, city smoke inspector; Mr. W. F. M. Goss, dean of the College of Engineering, University of Illinois; Mr. William B. Jackson, consulting engineer; Alderman Charles E. Merriam, professor of political science in the University of Chicago. These gentlemen serve without compensation.

At the same meeting of the City Council at which this request was received Alderman Britten introduced an ordinance, which was referred to the local transportation committee, and which, if enacted into law, will require all the railroad companies operating cars or trains of cars within seven miles of the city hall in the City of Chicago to propel them "by other power than that of steam, or in a manner that will not produce smoke or any noxious gases." The date fixed for the enforcement of the proposed ordinance is Jan. 1, 1913. A penalty in the shape of a fine of $200 a day for every movement of any car or train by steam power after the date mentioned is provided in the proposed ordinance.

Electric Vehicles at Chicago Automobile Show.

At the Chicago Automobile Show, to be held in the Coliseum from Jan. 28 to Feb. 11, 1911, there will be a representative showing of electric pleasure vehicles, delivery wagons and trucks. For the first time in the history of the Chicago Automobile Show the exhibition will extend over a period of two weeks. The first week will be devoted to the pleasure vehicles, which will be shown on the main floor of the Coliseum and Coliseum Annex and on the main floor of the First Regiment Armory. The electrical exhibitors include the Woods Motor Vehicle Company, Chicago; Columbia Motor Car Company, Hartford, Conn.; Baker Motor Vehicle Company, Cleveland; Studebaker Brothers Manufacturing Company, South Bend, Ind.; Babcock Electric Carriage Company, Buffalo; Waverley Company, Indianapolis; Anderson Carriage Company, Detroit; Rauch & Lang Carriage Company, Cleveland; Hupp-Yeats Electric Car Company, Detroit; Ohio Electric Car Company, Toledo, and Broc Electric Vehicle Company, Cleveland.

All of the pleasure cars will be removed on the night of Feb. 4, and on the following Monday the doors of the Coliseum will open for the first time upon a purely commercial wagon show. During this week electric vehicles built for industrial purposes will be shown by the Studebaker company, Waverley Company, General Vehicle Company, of Long Island City; Lansden Company, of Newark, N. J.; Automobile Maintenance & Manufacturing Company, of Chicago, and the Anderson Carriage Company.

Meeting of Electric Vehicle Association of America.

At a meeting of the Electric Vehicle Association of America held in New York on Dec. 20 two papers were presented, one by Mr. W. E. Holland entitled "The Alkaline Battery," and the other by Mr. R. E. Russell entitled "The Mercury-Arc Rectifier for Charging Vehicle Batteries."

The paper by Mr. Holland was devoted to the Edison nickel-iron, alkaline electrolyte battery, the development of which was described in detail. The chief operating characteristics of the Edison battery were outlined in our issue for Jan. 20, 1910; its application to street-railway service was discussed in our issue for Jan. 27, 1910, while its constructive details were described in our issue for April 28, 1910. Mr. Holland exhibited test curves showing that the ampere-hour output of the battery is practically independent of the rate of discharge. However, the voltage decreases with increase of discharge rate on account of the resistance of the battery circuit. Instead of being injured by severe treatment the battery is actually improved by being directly short-circuited. That is to say, the performance after being recharged following a direct short-circuiting is slightly better than before the short-circuiting took place.

In reply to a question by Mr. Arthur Williams, Mr. Holland stated that when completely discharged by short-circuiting the temperature reaches 220 deg. Fahr., which is sufficient to cause the electrolyte to boil. The conditions return to normal rapidly as the battery is recharged. The output obtainable from the battery is from 14 watt-hours to 18 watt-hours per pound.

The paper by Mr. Russell covered the operating characteristics and practical application of the single-phase mercury-vapor rectifier for charging vehicle batteries in public and private garages and homes. The type of equipment for each service indicated was described and illustrated. The "runabout" charging installation is designed for use at either 110 volts or 220 volts alternating current and delivering 30 amp direct current. The standard type for garage service operates at about 78 per cent efficiency when charging the usual type of vehicle battery. The efficiency varies with the charging voltage, but is almost independent of the load. In comparison with a motor-generator set, which has an efficiency of possibly 60 per cent, the rectifier is more efficient, more convenient and less expensive for a tube life of 300 hours or more. The actual life of a tube is 600 hours or more.

Mr. Russell stated that as a result of experience with both motor-generator sets and rectifiers in Cleveland ninety-three rectifiers had been placed in service to seven motor-generator sets. In reply to a question by Mr. T. I. Jones Mr. Russell stated that a rectifier set for charging a thirty-cell, 66-volt battery would have an efficiency of from 70 per cent to 75 per cent and would cost perhaps $185. In charging such a battery from a 110-volt direct-current circuit the loss would be 44 volts and the efficiency 60 per cent.

Mr. R. M. Searle said that in Rochester it has been found advantageous to install mercury-vapor rectifiers even where direct current is available. The prime requisite for rectifiers to be used in charging vehicle batteries is simplicity. All complications should be removed from the switchboard.

Mr. Alex. Churchward entered a plea for standardization of electric vehicle equipments, especially with reference to the battery e.m.f. There is no adequate reason for the existence of one e.m.f. for a commercial vehicle battery and a different e.m.f. for pleasure-vehicle battery. The e.m.f. should be of such a value that the batteries can be charged properly from 110-volt lighting mains.

Mr. T. I. Jones outlined the difficulties encountered by central stations in formulating a method for charging for the energy used by vehicle batteries. Neither a kw-hour rate nor a maximum demand plus a kw-hour rate seems to fit all cases.

Mr. Russell outlined the reasons for failures of mercury-vapor rectifiers to open the circuit automatically when the battery is fully charged, including defects in the battery as a cause for low counter voltage and poor line regulation as a possible cause for high impressed voltage. He said that it is best not to depend upon the automatic features of the rectifier for disconnection, but to install some positive circuit-opening device, such as a time switch.

The secretary of the association reported that the membership had reached the total of 106, thirty-four new applications having been received during the past month.

Transformer Discussion by St. Louis N. E. L. A. Section.

The Union Electric Light & Power Company Section (St. Louis) of the National Electric Light Association was addressed at its Dec. 16 meeting by Mr. E. G. Reed, of the transformer engineering department of the Westinghouse company, Pittsburgh. Mr. Reed recounted some interesting transformer history, discussing the work of the early inventors, and pointed out the theoretical differences between the core and shell types. He also made clear the distinction between the copper and iron losses in present transformers, and discussed the phase relations of the load currents and the exciting current. In the discussion which followed his talk Mr. John Fay, foreman of the overhead department of the Union Electric Company, brought out the point that grounding a three-phase transformer may make it possible to continue operation as an open-delta arrangement when one of the phases has been burned out.

Locating and Repairing Burnouts in Underground Transmission Lines.

An excellent paper on "Recent Improvements in Procedure for Locating and Repairing Burnouts in Underground Transmission Lines" was read by Dr. D. W. Roper, assistant to chief operating engineer and superintendent of the street department of the Commonwealth Edison Company, Chicago, at an extra meeting of the Commonwealth Edison branch of the National Electric Light Association on Dec. 20. The paper was illustrated by lantern slides and in addition the speaker displayed samples of burned-out cables, as well as an emergency kit for light repair work, an emergency telephone set and the Schweitzer potential detector for testing for "live" high-potential circuits in oil-switch compartments at the generating station.

Mr. Roper began by saying that the Commonwealth Edison Company has in service at the present time 525 miles of transmission lines and about 95 per cent of these lines consist of underground cables, representing, with the conduits in which they are installed, an investment of more than $4,000,000. These underground lines may be called the arteries of the system. Burnouts of transmission lines are far more numerous than those of generators or substation apparatus, and the quick repair of these lines after a burnout is of prime importance.

The first indication of the breaking down of a line is the automatic opening of its oil switch in the generating station, which is reported promptly to the load dispatcher and by him to the street department. The latter department takes steps immediately to make the necessary repairs. Arrangements are made with the company's transportation department for three vehicles. A gasoline automobile is obtained first, to be used by the men in locating the trouble; an electric truck, or possibly the emergency wagon, is used in sending tools and material, together with pumps for removing water from manholes, to the place where the trouble in indicated by test. The third vehicle required is a wagon or an electric truck which can be used for hauling the cable, and is equipped preferably with an electric windlass or winch which may be used for pulling the cable into the conduit.

A preliminary low-tension test is usually made to determine whether the cable is grounded sufficiently to enable a Murray loop test to be made. If practicable the loop test is made immediately afterward. Frequently the cable is not sufficiently grounded for the purpose, and the resistance of the fault must be reduced by burning it with energy from a testing set. The Murray loop test is considered the quickest and cheapest way to locate the trouble wherever it can be used. Under favorable conditions the accuracy of this test is within 0.1 per cent, and it enables the men to proceed readily to the manhole nearest to the seat of trouble. Ordinarily this test can be made within fifteen minutes after the preliminary tests have been completed.

If the Murray loop test cannot be used the trouble can be located frequently by the use of an exploring coil and a telephone receiver. As this method requires going over the conduit line, opening a number of manholes and locating the particular cable in question, an hour or more may be required to make it. About 20 per cent of underground cable troubles occur in manholes, and if there is an explosion the company is usually notified within a few minutes by the police or by some citizen.

Where all other methods fail resort must be made to the cut-and-try method. This consists in cutting the cable at the middle of the line and then making a test to determine in which section the trouble is located. Another cut is made in the middle of the section containing the fault, and so on, until the trouble is located between adjacent manholes. For a line two miles long five or six cuts may be required and three additional cuts would be necessary for the company's longest underground line, which is about sixteen miles long. This method may easily take two hours, and four hours would be considered good time for a long line. After the trouble is located there may be from two to seven extra joints to make, in addition to the two which are necessary to disconnect the injured section of cable.

Mr. Roper gave the following table to show the proportion of methods actually adopted to locate burnouts in cables in a given number of cases extending over a period of several years:

Loop test	46
Cut-and-try method	27
Reports of manhole explosions	11
Examining manholes	8
Exploring coil	6
Total	98

The exploring coil method is more effective than indicated by the table, as its use extends over only one-third of the time covered by the above list of burnouts, and it is utilized only after the failure of the Murray loop test.

Frequently water has to be pumped out of a manhole in which it is necessary to cut the cable. Before cutting the cable it is important that the men should be sure that they have the right one, and in crowded manholes this is not always a simple task. It would be a serious matter to cut into a cable which was alive. An electroscope will indicate the presence of high-tension energy, but it requires the removal of the lead sheath before it can be used. Ordinarily the repair men depend upon the company's records, and in case of doubt it is always possible to follow the cable for some distance and determine its destination in this manner.

When the burnout is located between two adjacent manholes this section of the cable is removed and a new piece of cable installed in its place. After the new piece of cable is pulled in, and before making the last joint, it is necessary to identify the phases in order to retain the correct phasing of the connections in the substation. Finally, a high-tension test is necessary to determine if the cable is in proper condition, with the phases properly identified and connected.

The speaker gave a table showing that the actual time consumed for locating, repairing and testing an underground cable burnout under actual conditions was fourteen hours and thirty-nine minutes as the average of five cases. Under ideal conditions this time might be reduced to five hours, perhaps, and as it is often of great importance to repair the damage as quickly as possible every effort is made to make the actual time approach more closely to the time required under ideal conditions, although in practice it will never be possible to meet the ideal conditions exactly.

Mr. Roper then took up recent improvements in methods and equipment for this class of work. He first spoke of the Schweitzer potential detector, consisting of one or two small lamps in series with a high resistance, which is used in the switch house of the generating stations to make test on 9000-volt lines and buses to determine whether they are live in the same manner that a wireman would use a test lamp on low-tension switches and connections.

Extension of the use of the Murray loop test in one of the most profitable fields for investigation. The use of this test has heretofore been limited to cases where the resistance of the fault was less than 1000 ohms, and the burning of the cable for several hours, in the endeavor to reduce the resistance of the fault, has not been a rare occurrence. The resistance is liable to be high when the original burnout was rather severe, so as to burn off a large amount of lead in proportion to the area of copper exposed, or where the fault occurs under water. Recent experiments with artificial grounds of known resistance indicate that the loop test will be reliable with the fault resistance as high as 50,000 ohms, and a further extension of this limit appears possible by obtaining a galvanometer of higher resistance than the present one and using a slide wire of a resistance corresponding to maximum accuracy.

If the fault is submerged the leakage of energy from the auxiliary conductor may be sufficient to render the test worthless, and this has been the apparent cause of misleading results obtained in several tests under these conditions. There are two methods of determining whether leakage of this kind is affecting results—first, by measuring the insulation resistance of the conductor used to complete the loop, and, second, making the loop test from both ends of the line.

To communicate with the load dispatcher after the line has been cut to locate trouble a signaling scheme has been devised. Energy is applied to each end of a grounded conductor through an incandescent lamp. If the resistance of the fault is low both of these lamps will burn. When the cable splicer cuts the cable he will always have a defective piece of cable on one side of the cut and a length of good cable on the other side, leading to a generating station or a substation. When a cut is made the lamp in the station will go out and the other lamp will continue to burn. The cable splicer can then, with a test lamp, use the energy from the live conductor for the purpose of signaling by flashes of the lamp to the station. A simple code of signals has been devised for this purpose.

The identification of cables in a manhole is of much importance, and a careful system of records has been worked out to enable this identification to be made in any manhole on the company's system. As a precaution, however, the lead is always removed from the sleeve covering the joint and test made with an electroscope in all cases where the identification is not positive. The exploring coil can frequently be used to advantage for this purpose, and the street department of the Commonwealth company is endeavoring to extend the field of usefulness of this instrument in this direction.

An emergency telephone outfit is provided for the use of the foreman on the ground after the trouble has been definitely located. If a telephone line to which this outfit can be attached is available the equipment may be in use within from one to two hours after the order is placed. An "emergency kit" contains a complete set of tools used by a cable splicer, together with the material for making up one joint on any of the several varieties of high-tension cable. These kits are useful where the burnout is not serious, and it is customary to put one of them and an emergency telephone in the first automobile that goes out on the trouble call.

All cable for future transmission lines is to be furnished with one conductor marked by a thread wrapped around the insulation. This scheme, which has been used for many years on telephone and telegraph cables, will eliminate the necessity of testing for phases when making up the last joint.

In concluding his instructive paper Mr. Roper said that the entire procedure in testing and repairing underground transmission lines of the Commonwealth Edison Company has recently been revised by a committee consisting of Messrs. Guy W. Lunn, J. T. Mountain, F. J. P. Seuel, B. E. Strohm, E. O. Schweitzer and D. W. Roper. Many of the recent improvements in the company's methods are due to the suggestions of this committee

Following the reading of the paper there was an intermission of ten minutes, during which an opportunity to examine Mr. Roper's "exhibits" was given. Mr. E. F. Smith presided at the meeting, at which the attendance was about 230. Mr. A. P. Thoms, chief load dispatcher, opened the discussion. He spoke of the work of the load dispatcher in connection with cable repairing and said that he is the man who takes charge of the entire procedure in case of a break-down. He gave some instances where the use of the exploring coil had proved of practical value.

Mr. P. Junkersfeld, of the vice-president's office, emphasized the necessity of maintaining the underground transmission lines which are the arteries of the Edison system in Chicago. He said that the public judges the company not by its successes, but by its failures. The underground cables not only represent an investment of $4,000,000 in themselves, but any breakdown in them reflects on the whole system. The speaker remarked that more has been learned in the last year in relation to the work of testing and repairing underground cables than in the preceding fifteen years. There is still something to learn, however, and the importance of the subject can hardly be overestimated.

Mr. B. E. Strohm, general foreman of the underground department, told of some interesting cases of troubles on underground lines. In one case the keel of a boat in the North Branch of the Chicago River caused a break-down by injuring a cable laid in the bed of the river at a crossing.

Mr. J. C. Johnson, assistant chief electrician of the Fisk Street generating station, discussed briefly the "trouble" work from the station operator's point of view.

Mr. Guy W. Lunn, chief electrician of the Fisk and Quarry Street stations, in a lively speech, described the scene at the station when there is trouble on a line.

Mr. D. E. Rivers said that, in addition to mechanical accidents or defects, electrostatic capacity of cables had something to do with the breaking down of the dielectric strength of the cable.

In answer to Mr. E. W. Grover, Mr. Roper said that he could recall only one case of trouble which could be traced definitely to potential surge.

Mr. P. B. Juhnke touched on the question of co-operation between men in all departments of the company. There are few accidents, considering the number of line changes due to the growth of the high-tension system in Chicago. He suggested a possible new use of the Schweitzer testing device in manholes, as well as in the generating station, and Mr. Roper thought that the idea was worthy of investigation. Messrs. W. L. Abbott and H. L. Gannett also spoke briefly.

Canadian Hydroelectric Commission News.

On Saturday, Dec. 17, F. H. McGuigan, contractor for the Hydroelectric Commission's transmission lines, announced to Hon. Adam Beck, chairman of the Commission, that the lines were now all completed. With the completion of the loop from St. Mary's and the line to St. Thomas, reaching off south from London, there is but the stretch from the Humber River to Toronto station to bring the whole undertaking to final completion. Two hundred and ninety-three miles of lines have been constructed from Niagara Falls westward, and the construction force, which was laid off on Dec. 17, has been working steadily for two years. It is expected that the Commission will now consider the question of extending the line further west from London to Windsor.

On Dec. 20 the city streets of London were officially lighted with Niagara energy, the current being turned on at the Armory by Hon. Adam Beck, in the presence of thousands of citizens. Chairman Ald. Pocock of the Water Commission stated that London now has a rate of 4½ cents per kw-hour, cutting the former price in half and making it the cheapest rated city in Canada. There were 2800 customers, who last year paid $70,000 for their power. The civic water board had about 12,000 customers, and if as many could be secured in London for the hydroelectric power he felt it was possible to reduce the rate to 4 cents or even 3 cents. Hon. Adam Beck said that at 4½ cents per kw-hour London was receiving the cheapest electric lighting in America. He expected that by the first of the year the Commission would be able to take up the question of individual lighting and wiring of houses in London. The Commission had a surplus of $25,000 over the first estimate of the cost of installing hydroelectric power in London.

The formal lighting of the city's streets with Niagara energy was made the occasion of an electrical exhibition at the Armory, where a number of interesting exhibits were made by various electrical firms in Canada.

On Dec. 21 Hon. J. S. Hendrie, member of the Commission, pressed the button at Hamilton, which was the occasion of the turning on of Niagara electric power when the electric pumps were operated at the waterworks station at the beach. The test was satisfactory, and the waterworks system will be operated with electric power continuously in a few days. The ceremony of turning on the Commission's power at Hamilton was made the occasion for a large gathering of prominent citizens and manufacturers, concluding with a banquet at the Hotel Royal in the evening.

Hon. Adam Beck made the principal speech. He said the Commission's transmission line was 376 miles long, with tributary lines 100 miles, making it the longest transmission line in the world. Opponents of the project had predicted that the cost would be $10,000,000, but it was built for $3,500,000. He predicted that not only would the DeCew Falls generating station of the Cataract Power Company be incapable of supplying the power needed for Hamilton, but the supply at Niagara Falls would also be exhausted by the demand throughout Ontario, and it would be necessary to develop other water-powers. Hamilton had large interests and cheap electric power before the Hydroelectric Commission was organized, but it did not enjoy as cheap rates for street and house lighting and small power users as it should have, so it had benefited by the Commission already, the Commission affording legitimate competition. London, by hydroelectric power, although three times as far removed from the source of supply as Hamilton, had a rate of 4½ cents per kw-hour for house lighting, while Hamilton paid 8½ cents. With the Commission's power there the rate would be about 3½ cents.

The sale of power at Windsor would reduce the price by 10 per cent. Hamilton would be asked in the course of two or three months if it wished to share the responsibility and advantages of that sale by taking a co-operative contract. All the speakers paid a tribute to Mr. John Patterson (the founder and promoter of the Cataract Power Company) for being the first to introduce long-distance transmission of hydroelectric power in Canada.

The proposed turning on of electric lights at Toronto with Niagara power, which was intended to take place on New Year's night, has been held up by an action instituted by Mr. G. P. Magann, who has complained to the Dominion Minister of Public Works that the commission's transmission line running through South Parkdale (a portion of West Toronto) has been weakly constructed and is a constant source of danger. Mr. Magann has asked that the plans for the transmission line constructed be not approved until the stability of the wires has been investigated. The fact that the line runs along the shore of the lake or navigable territory is said to place the matter within the jurisdiction of the Dominion government.

When the contractors, F. H. McGuigan & Company, commenced the construction of the line, about five weeks ago, it was planned to locate one of the towers on Mr. Magann's property with the understanding that he should be reasonably compensated. Mr. Magann's property, which fronts on Dowling Street, near Lake Ontario, is said to be worth $70,000, but the sum asked for giving the tower a resting base was considered exorbitant. The commission, however, it is understood, was prepared to pay a substantial sum to compensate Mr. Magann until it was found that the city was willing to have the tower placed in the street allowance, and there it was erected.

Mr. W. K. McNaught, a member of the Hydroelectric Commission, stated that the towers were constructed on the same lines as are all similar works in America, that the Dominion government's resident engineer, Mr. J. G. Sing, was perfectly familiar with the work, as well as the commission's engineer, and that he expected when Mr. Magann's application was heard by Hon. Mr. Pugsley, Minister of Public Works, on Dec. 30, the plans would be duly approved, which would mean the delay of only one week in the time promised for delivery of power at Toronto.

The light and heat commission of the City of Stratford (Ont.) have announced the following tariff for Niagara electric power to be supplied to the town by the Hydroelectric Commission and distributed by the town:

House customers, 3 cents per month per 100 sq. ft., less 10 per cent reduction for walls and partitions, cellars and attics not to be counted unless occupied for actual residential purposes; also 6 cents per kw-hour, with no meter charge, less 10 per cent discount for payment by the fifteenth of the month. In addition free carbon-lamp renewals of 8 cp or 16 cp with proviso that the householder purchase first equipment from the commission. The rate works out to be 8 cents net per kw-hour.

An alternative rate is 9 cents per kw-hour, with no meter charge, and 10 per cent discount and carbon-lamp renewal as above. Shops, theaters, hotels and factories, 9 cents per kw-hour; churches the same, with 20 per cent instead of 10 per cent discount. Sign, window and display lighting, $6 per month per kilowatt connected, with 10 per cent reduction, but no lamp renewals. The old rates for houses were 15 cents per kw-hour, less 20 per cent reduction, plus 25 cents a month meter rate. The power standard recommended by the conference of engineers of Niagara power municipalities was adopted.

New York Commission News.

The Public Service Commission of the First District held two hearings last week upon the application of the Long Acre Electric Light & Power Company for permission to issue $10,000,000 of capital stock and $50,000,000 of 5 per cent bonds. This application was once refused by the commission, but the Appellate Division of the Supreme Court decided that the grounds of refusal were insufficient and ordered that a rehearing be granted. At the hearings last week Henry J. Hemmens, counsel for the New York Edison Company, opposed the Long Acre application and argued that the new company had no right to operate under its present franchise. The attor-

neys for the Long Acre company contended that the Edison company had no standing in the proceedings and claimed that it was a monopoly endeavoring to choke off competition. Last week's hearings were entirely occupied with the arguments of the attorneys. The case was adjourned until Jan. 4.

There were two hearings last week by the Public Service Commission of the First District upon the complaint made by consumers in Far Rockaway against the Queens Borough Gas & Electric Company that rates were too high. The hearings were devoted to the testimony of expert accountants as to the cost and value of the plant. The hearings were adjourned subject to the call of Commissioner Maltbie.

The Public Service Commission, Second District, has consented to the issuance by the Niagara & Erie Power Company of a mortgage upon its property, rights and franchises to the Guaranty Trust Company of the City of New York to secure the payment of $1,250,000 in 5 per cent thirty-year bonds. The company is authorized to issue at present $510,000 of its bonds for cash at not less than 85 and $100,000 of its capital stock at par. The bonds are to be used to acquire certain property of the Niagara, Lockport & Ontario Power Company, consisting of its Gardenville substation and distributing system, and from the Buffalo & Lake Erie Traction Company the electric light, gas and heating plant and the capital stock of the Fredonia Natural Gas Company, the transmission lines in the towns of Checktowaga and Amherst, Erie County, and for miscellaneous expenses in connection therewith. The proceeds of the capital stock are to be used in payment to the Niagara, Lockport & Ontario Power Company for part payment in acquiring the Gardenville substation and distributing system and high-tension transmission line extending from the property of the Lackawanna Steel Company in the City of Lackawanna to the switching and transformer station of the Buffalo & Lake Erie Traction Company at Athol Springs. Ten thousand dollars of the capital stock is to be paid to the Buffalo & Lake Erie Traction Company for part payment for the electric light, gas and heating plant and for the capital stock of the Fredonia Natural Gas Company in the village of Fredonia, Chautauqua County. The commission has consented that the Buffalo & Lake Erie Traction Company may transfer to the Niagara & Erie Power Company the plant and franchises referred to above, in the village of Fredonia, and has also consented that the Niagara, Lockport & Ontario Power Company may sell to the Niagara & Erie Power Company the property mentioned above.

The commission has received a complaint from twenty-five residents of the village of Sea Cliff, Nassau County, directed against the Nassau Light & Power Company, alleging exorbitant rates for the use of electricity for lighting purposes. The charge for commercial service was at one time fixed at 10 cents per kw-hour, and when the original company was taken up by the Nassau company the price was raised to 15 cents per kw-hour. The commission is asked to reduce the rate to 9 cents, which the complaint alleges is a just and reasonable rate and affords ample and just returns on the company's investment.

The Hartwick Power Company has been authorized to execute and deliver a mortgage to the Trust Company of America to secure an issue of $750,000 of thirty-year 5 per cent bonds. The company is authorized to issue presently $400,000 of these bonds to be sold at not less than eighty, also to issue its capital stock to the amount of $300,000 par value. The proceeds are to be used in payment to the Susquehanna River Power Company for the purchase of a hydroelectric development system on the Susquehanna River at Colliers, Otsego County, consisting of dams, storage reservoir, all flow lands, power house and transmission line from the hydroelectric plant to the steam-power electric plant at Hartwick, Otsego County, and in payment to the Trust Company of America of certain expenses paid by it for the construction of the hydroelectric development system at Colliers of the transmission line; also for the purchase from the Otsego & Herkimer Railroad Company of the steam-power electric plant formerly owned by the railroad company situated at Hartwick, and for improvements and betterments made by the Trust Company of America to the steam-power plant.

The Niagara Falls Power Company has been authorized to issue its common capital stock to the amount of $1,534,000 par value, the proceeds to be used in the discharge of its ten-year 6 per cent debentures, Series A, to the amount of $614,000; 6 per cent debentures, Series B, to the amount of $815,000, and 6 per cent debentures, Series C, to the amount of $105,000.

The Deer River Power Company has been authorized to exercise franchises granted in the towns of Denmark and Champion and in the village of West Carthage, Jefferson County, for furnishing and distributing electricity in these places.

The Patchogue Electric Light Company has been authorized to issue $30,000 additional common capital stock to be sold at par and for cash, the proceeds to be used in payment of obligations incurred by this company in improving and adding to its equipment; also for the completion of lines between the power station at Patchogue and the substation at Center Moriches.

The Utica Gas & Electric Company has been authorized to issue $500,000 par value of its remaining unissued $3,000,000 5 per cent fifty-year gold bonds. The proceeds derived from the sale of the bonds are to be used for the discharge of an indebtedness incurred on account of construction and extensions of its plant. The bonds are to be sold at not less than 95.

The Owego Light & Power Company has been authorized to issue $32,000 of its twenty-year 5 per cent gold bonds. The proceeds are to be used to pay in full and discharge the present outstanding indebtedness of the company, and also notes and bills payable incurred for proper capital purposes.

The Bolton Light & Power Company has been authorized to exercise franchises granted it for the furnishing of electricity in the town of Bolton, Warren County, and also to issue 250 shares of its common capital stock, total par value of $12,500, and to issue its ten-year 6 per cent first mortgage bonds to the amount of $10,000, to be sold at not less than par, the proceeds of the stock and bonds to be used for the construction and equipment of its plant.

Wisconsin Commission News.

By virtue of a decision recently announced by the Railway Commission the Southern Wisconsin Railway Company, of Madison, has been ordered to publish a proper train schedule and make the same reasonably accessible to the patrons of its lines and to operate its cars accordingly. Ten days is deemed a sufficient time within which to comply with the order.

At a hearing held on Sept. 16, 1910, the respondent admitted that the number and type of cars used on this line were not satisfactory, but said it was compelled to use them because of its inability to acquire new cars at a more rapid rate. In regard to the use of old cars the commission comments as follows: "It appears to us that the public cannot reasonably object to such cars, provided they are maintained in serviceable condition and are capable of doing the work required of them. Both the public and the company will be the gainers if equipment which is still in serviceable condition is used as long as practicable and not scrapped in advance of necessity. It is obvious that any waste in the use of cars must be made up out of the revenues of the company contributed by the public."

In reference to the company's plea of poverty as an excuse for poor service the commission has this to say: "We are unable to recognize as valid the financial reasons advanced by the company for its alleged inability to acquire new cars, because in our judgment the present business of the respondent company is in excellent condition. The company is earning an extremely satisfactory rate of return upon the property devoted to public use. To be sure, it is doubtless heavily handicapped by its present financial history, for which the present management may not be responsible except in so far as it has voluntarily inherited this abnormal financial situation through purchase at a price. Whatever the weight of this

handicap may be and whatever consideration it may deserve, it cannot be recognized as a valid basis in an attempt to plead the financial inability of the company as a reason for not adequately serving the public. The company must be considered financially able to do whatever may reasonably be required in the interests of good service."

Following the hearing the engineers of the commission conducted an exhaustive investigation of the company's service, and the decision was based largely upon the results of this investigation. Observations made regarding the schedule showed that there was practically no schedule, but that the cars were supposed to maintain a certain headway. The investigation showed that out of every hundred attempts to board a car at a certain street the passenger would fail to find a car at that point at the normal time from forty to eighty-seven times, depending upon the particular street corner at which the attempt was made. This unreliability of the cars was considered sufficient proof that if a normal schedule had as a matter of fact existed, as respondent testified at the hearing, there was nothing in the operation of the cars to show an appreciable tendency toward its observance. The investigation showed further that the trainmen themselves apparently knew little about a running schedule, and also that they lacked definite information with respect to the various matters connected with the operation of the cars. "This suggests," says the commission, "a probable lack of systematic instruction and the proper disciplinary superintendence to enforce the reasonable observance of rules and regulations." It was pointed out that this condition of affairs was clearly the fault of the management for not properly performing the duties which unquestionably are its. .....

The commission in discussing the difficulties arising in maintaining a schedule under certain abnormal conditions on a single-track line recommended that the company adopt a simple block-signal system such as has been used with success on other single-track lines in the country. It called attention to the fact that some such system is necessary before satisfactory service can be given, even after a good schedule has been adopted.

Under the terms of the decision the company will be obliged to adopt a rigid schedule instead of running its cars on a headway, and after the schedule has been published the cars must be run accordingly.

In a decision dated Dec. 16 the commission has ordered the Whitewater Electric Light Company to make such readjustments in its lamps and other equipment as will enable it to supply 432 watts of electrical energy at each of its arc lamps, and that its service in other respects be brought up to the standards that are reasonable and adequate. The decision arose out of a petition filed by the City of Whitewater in which it was alleged that, among other things, the electric company has not and is not now furnishing arc lights of the standard illuminating power of 2000 candles each with 432 watts at the arc as agreed and required by the terms of a certain contract previously entered into by company and municipality. The hearing was held in Madison on May 23, 1910. The chief points in controversy related to the valuation of the property as made by the engineers of the commission and the character of the service rendered by the respondent company. The value of the plant as determined by the commission was $43,446, apportioned 70 per cent to the incandescent and 30 per cent to the arc service. The company claimed a total valuation of $59,347, but investigation showed that this value could not be allowed because of the failure of the respondent to distinguish properly between cost of renewals, extensions to the plant and depreciation. Several items in the valuation were objected to, but the commission could see no reason for deviating from the figures determined upon by the engineers.

In arriving at the cost of service it was necessary to estimate the probable maximum demand, inasmuch as the company was unable to furnish the necessary information. The average connected load per consumer and the ratio of maximum demand to connected load for fifty companies in the State, having from 200 to 500 consumers, gave a value of 1.04 for the former and 0.45 for the latter. Also the statistics compiled from thirty plants, serving from 2000 to 4000 population, showed a median of 288 consumers, a plant capacity of 200 kw and connected load of 242 kw, a maximum demand of 115 kw and a total operating expense of $5,904. Checked by these values the maximum demand appeared to be considerably higher than the estimate furnished by the company, and was accordingly used in the calculation. The operating expenses as reported by the company were in excess of the average quoted above, but there was no testimony to show that expenses of the plant in question were excessive.

The arc lamp now in use is an alternating-current series arc requiring 7 amp and 432 watts at the arc. The city pays $80 per lamp per year. It appeared from all the data available that $90 per lamp is the lowest amount at which the respondent can fulfil the terms of its contract and secure a proper return upon the property used.

In regard to the 2000 cp which the city alleged was not being received, and the penalties provided for the failure to furnish such candle-power, the commission says: "The term '2000 cp' in the contract between the parties to this case is merely a nominal rating and does not represent the actual amount of light given, and the provision of the contract providing for the city deducting a certain amount in case the lamps do not reach the stated illuminating power is impossible of enforcement." The commission points out that the only test which would indicate whether lamps in Whitewater came up to the specifications in the contract would be the watt test. A series of inspections made under the direction of the commission showed that most of the globes were dirty, that the lamps were hung without reference to any standard height, and that there is a considerable obstruction to the light. The tests that were made at the same time showed that all lamps tested were operating below the standard watts by amounts varying from 17 watts to 100 watts. A difference of 0.4 amp in the current of the two circuits was observed. The report states that the company is equipped with adequate facilities for remedying the defects observed, and consequently there is no valid excuse for their existence.

The commission called attention to the fact that merely keeping the energy at the prescribed watts did not necessarily mean satisfactory service, but that there were influencing factors to which attention was called, and these must be carefully looked after.

The commission further did not consider that the fact of the city getting its light at less than cost was any reason why the service should not be ordered kept up to standard. The earnings of the plant as a whole, while not unreasonably high, were high enough to warrant a reasonable standard of efficiency.

Maryland Commission News.

The Maryland Public Service Commission will consider a request made by the City of Baltimore for a revision of rates for both gas and electric service. The Mayor will advocate the adoption of the London sliding scale of rates. The case has been under advisement for some time and the Mayor has employed experts to look into the local conditions and submit reports. The expert who was assigned to the investigation of the electric rates has already placed his detailed report in the hands of the Mayor. Mr. Charles E. Phelps, chief engineer to the Public Service Commission, is of the opinion that the Boston or London sliding scale of rates would be the most equitable plan to adopt as a means of adjusting both gas and electric rates in Baltimore. The London sliding scale is a profit-sharing arrangement between the supply company and its consumers. It is automatic and for that reason if it is once adopted will be a permanent method of regulating rates. It

provides that the company is entitled to earn fair dividends on its actual investment, but that dividends may only be increased according as the price of the commodity is decreased; or, as provided in Boston, the company for every stated reduction in its rate may earn an additional dividend. If this plan of rate regulation is adopted by the commission it does not necessarily follow that the present rates need be lowered. A complete consideration of the subject requires that a full and comprehensive valuation of all of the company's properties be made and a capitalization determined commensurate with this valuation, and also an investigation made of all of the costs of operation, administration and distribution in placing the gas or electricity on sale. Mr. Robert J. McCuen, superintendent of the Department of Lamps and Lighting, has expressed the opinion that the Consolidated Gas, Electric Light & Power Company may voluntarily consider this suggestion; that there is a good possibility of its adoption in view of the fact that Mr. Aldred is now at the head of the compnay.

An argument against the abolition of the unlimited service contract as proposed by the Chesapeake & Potomac Telephone Company was submitted to the Public Service Commission last week by Owen Daly & Company. It consisted of a statement showing the financial condition of the American Telephone & Telegraph Company, the holding company of the Chesapeake & Potomac Company. According to the statement the gross earnings of the former company are increased at an annual uniform rate of nearly 11 per cent, and the net earnings at a ratio of about 5 per cent each year. Owen Daly & Company complained that the rate for unlimited service was sufficiently high and that the company should not be allowed to install a system by which its revenue from the citizens of the State would be so materially increased. The complaint intimated that there was practically no opposition in the telephone field in the State and that the people's rights rested entirely with the commission, which was urged to take some definite action in this matter of telephone rates.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission will give a hearing on Jan. 6 upon the petition of the Weymouth Light & Power Company for authority to issue additional capital stock to the amount of $210,000. The board has nearly completed its report on high-tension-transmission conditions and laws to be presented to the incoming Legislature.

The Railroad Commission has received a petition from the Selectmen of Attleboro asking that the board require the Interstate Consolidated Street Railway Company to provide reduced fares for workingmen during certain hours in the morning and evening.

AMERICAN ELECTRICAL ENGINEERS.—XXV.

H. C. Specht.

Hans Christian Specht was born in Farmsen, Hamburg, Germany, Aug. 24, 1876, where he received his primary education. When eighteen years old he entered the machine shops of the Grotkast & Kespohl Machine Company at Wandsbeck, Germany, as an appentice, and a year later entered on a two-year apprenticeship course with the Klamberg Electric Company at Hamburg, Germany. During his apprenticeship period he gained practical experience in the manufacture of electric generators, motors, detail apparatus and in the installation of electric power plants. Next came a service of one year in the engineering corps of the German army at Berlin, following which for two years he studied mechanical and electrical engineering at the Ducal Technical High School at Braunschweig, Germany. Being attracted by the reputation of Prof. E. Arnold, he then went to the Grand Ducal Technical High School of Karlsruhe, Germany, from which he was graduated with the degree of Electrical "Diploma Engineer" in 1901. During the long summer vacations he worked in the engineering office of the steamship department of the state of Hamburg and also served again in the army engineering corps.

In May, 1902, Mr. Specht accepted a position as electrical engineer with the Submarine Cable Company at Nordenham, Germany. During this period he took part in several expeditions for the repair of cables in the English Channel and Atlantic Ocean, and was also engaged in the laying of the second German Atlantic cable from the island of Borkum via the Azores Islands to New York.

As it was not his intention to become a specialist in submarine cables, Mr. Specht resigned in September, 1903, and came to this country in fulfilment of a desire of many years' standing. In October, 1903, he obtained a temporary position as winder of alternating-current generators and motor armatures in the shops of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa., and after two months was transferred to the dynamo test department for duty in working up test curves of all kinds of generators and motors. Four months later he was put in charge of the engineering work in the latter department. During this period he worked up a new practical diagram for induction motors, an account of which was published in these columns in the issue of Feb. 25, 1905. In October, 1905, he was transferred to the engineering department for work in the designing of induction motors. Besides designing motors for ordinary industrial work he made a special study for some years of the electric drive in cement and steel mills. Of special designs may be mentioned the large rolling mill motors for the Indiana Steel Company, at Gary, Ind.; the Illinois Steel Company, at South Chicago; the National Tube Company, at Lorain, Ohio; the American Steel & Wire Company, at Birmingham, Ala., and the Cambria Steel Company, Johnstown, Pa., all built at the Westinghouse works.

H. C. Specht.

In 1908 Mr. Specht presented at the Atlantic City convention of the American Institute of Electrical Engineers a paper on "Induction Motors for Multi-Speed Service, with Particular Reference to Cascade Operation," and in 1909 at the Frontenac convention of that body presented a paper on the "Function of Flywheels in Connection with Electrically Operated Rolling Mills." A series of articles on different methods of obtaining

multi-speeds with induction motors and their practicability was contributed in 1909 to the *Electric Journal*, appearing in the issues of July, August, October and December. In June, 1906, Mr. Specht delivered a lecture on "Submarine Cables: Their Construction, Laying and Repair," before the Engineers' Society of Western Pennsylvania, which was printed in the *Proceedings* of that society for July, 1906.

Mr. Specht is a member of the American Institute of Electrical Engineers, the Elektrotechnischer Verein and Verband, of Germany, the National Geographic Society, and the German-American Technical Society of Pittsburgh, of which latter body he has been vice-president since October, 1909.

CURRENT NEWS AND NOTES.

Damages for Omitting Name from Telephone Directory.—A court at Sterling, Ill., has awarded $10 damages to a telephone subscriber whose name was omitted from the directory of the Central Union Telephone Company.

Automobile Engineers at New York.—The annual convention of the Society of Automobile Engineers will be held in New York City Wednesday and Thursday, Jan. 11 and 12. Mr. Howard E. Coffin, of Detroit, Mich., is president of the society.

Church Lighting by Wind Energy.—English newspapers report that Rev. W. Spencer, vicar of Coseley parish church, in Staffordshire, has caused to be erected a windmill 18 ft. in diameter near the churchyard, and by this means generates electrical energy to light the church and vicarage and operate the organ motor. No doubt a storage battery is also used in connection with this intermittent source of energy.

American Investments in Russia.—A St. Petersburg press dispatch announces that Mr. John Hays Hammond arrived in that city on Dec. 12, representing a group of American capitalists who may, it is said, make investments in Russian commercial and industrial enterprises, including electric lighting and street railway plants. Mr. George M. Wilenkin, Russian financial agent at Washington, is said to be co-operating with Mr. Hammond.

Examination for Assistant Physicist.—The United States Civil Service Commission will hold an examination Feb. 8 to fill as they may occur positions as assistant physicist and laboratory assistant in physics in the Bureau of Standards, Washington. The salaries are respectively $1,400 to $1,800 and $900 to $1,200 per annum. A circular (No. 50) on the subject may be obtained upon application to the Bureau of Standards.

Illuminating Engineering at Massachusetts Institute of Technology.—The subject of illumination and photometry has been added to the subjects taught in the electrical engineering department of the Massachusetts Institute of Technology. This is treated from the standpoint of illuminating engineering and is made an optional study. The instruction is by lectures, recitations and laboratory work under the direction of Professor Wickenden, who is the author of a work on "Illumination and Photometry."

Electricity on the Farm.—The American Society of Agricultural Engineers held its annual meeting at Purdue University, Lafayette, Ind., Dec. 27 and 28. Among the subjects discussed was that of the use of electricity in farm work and about the farmhouse from both isolated-plant and central-station sources of supply. Mr. P. S. Rose, of Madison, Wis., is president of the society and Prof. E. W. Hamilton, of Ames, Ia., is secretary. The arrangements for the Lafayette meeting were in charge of Prof. William Nye, of the farm mechanics department of Purdue University.

New York Section of I. E. S.—A meeting of the New York Section of the Illuminating Engineering Society will be held on Jan. 12, at which the following four papers will be presented: *Artificial Illumination as a Factor in the Production of Ocular Discomfort*, by Dr. Nelson M. Black, Milwaukee, Wis.; *Physiological Points Bearing on Glare*, by Dr. P. W. Cobb, physiologist of the National Electric Lamp Association, Cleveland, Ohio; *Reflection Coefficients*, by Mr. Paul Bauder, of the National Electric Lamp Association, and *Photometry of Mercury-Vapor Lamps*, by Dr. J. C. Pole, of the Cooper Hewitt Electric Company.

Government Control of Telegraph and Telephone Companies.—By the act of June 18, 1910, telegraph and telephone companies doing an interstate business in the United States were placed under the jurisdiction of the Interstate Commerce Commission. In its annual report, submitted to Congress on Dec. 21, the commission says that steps have been taken for the formation of a system of operating tariffs for these companies, and it is expected that this system will become effective July 1, 1911. Concerning the application of the law to telegraph and telephone companies the report says: "There are from 25,000 to 30,000 telephone companies which make provision for interstate communication, and the commission is in doubt whether it was the intent of Congress to place all these companies under its supervision and control. No opinion is expressed at this time as to the administrative interpretation which should be placed upon the law in this regard."

N. E. L. A. Membership Over 6000.—The National Electric Light Association continues to enjoy the growth which it has experienced so remarkably during the past eighteen months. On Dec. 12 the membership reached the high mark of 6007, inclusive of 904 operating companies and 222 manufacturing concerns. The operating companies and their sections have 4133 employees and members of their staff in Class B membership. The membership in July, 1909, was 3137, and at the meeting of the executive committee last January was reported as 4500, so that the net growth during the present year, after dropping 250 individual members for various reasons, is around 1500. Mr. H. H. Scott, the energetic chairman of the membership committee, has, with the aid of a large and enthusiastic committee, just set on foot another membership campaign, and there seems every reason to believe that 1911 will witness a growth in every way equal to that just noted.

"Motor Drive" on a Kansas Farm.—A large electrical manufacturing company recently received an order from a farmer in Kansas for a 30-hp motor to drive some of his farm machinery. The farmer wrote that he had read of the advantages and economies of electric drive, and from one of the company's catalogs had selected the rating, speed and voltage of the motor he thought fitted for his needs. As the amount of the full list price of the motor accompanied the order, the machine requested was shipped immediately without further inquiry. Full wiring diagrams accompanied the motor, but two weeks later the farmer wrote back that his new motor would not run. He was sent a letter of instruction and more wiring diagrams, but again the answer came back that, although everything was connected up just as shown in the drawing, the motor still refused to budge. Finally the electrical manufactory sent one of its men from a Western office to inspect the Kansas farm installation and determine the trouble. He found the motor wired up exactly as the plans called for, but he also found that there was not an electric line wire within twenty miles of the truly "isolated" motor installation. The disappointed farm owner, to whom the necessity for a source of energy supply had never occurred, then sadly accepted the generous offer of the manufacturer to take the machine off his hands at cost price and treat the whole transaction as a joke.

League of Electrical Interests, St. Louis.—The annual election of officers of the League of Electrical Interests of St. Louis will be held at the Missouri Athletic Club on the evening of Jan. 10. The entertainment committee is planning some novel and interesting "stunts."

Proposed Colliery Transmission in Indiana.—It is reported from Indianapolis that Mr. T. N. Stilwell and associates propose to establish electric generating stations at one or more coal mines in Indiana to transmit energy within a radius of seventy miles for general light and power purposes. It is said that the first plant will be erected at Bedford. According to the newspapers coal lands in several locations have been secured and construction work will be begun soon.

Agricultural Engineers Discuss Farm Electricity.—At the convention of the American Society of Agricultural Engineers, held at Lafayette, Ind., Dec. 27 and 28, Prof. L. J. Smith, of Manitoba Agricultural College, read a paper on "Means of Prevention and Control of Lightning," and Mr. E. P. Edwards, of the General Electric Company, Schenectady, N. Y., discussed "The Promise of an Electrified Agriculture." Mr. P. S. Rose, of Madison, Wis., is president of the society.

Rejuvenation of Sons of Jove in Chicago.—Careful preparations are being made for a rejuvenation of the Sons of Jove, which will be held at the Coliseum, Chicago, during the Electrical Show, on the evening of Jan. 20. Committees on membership, dinner and publicity have been organized, and they are actively at work. Following the initiation there will be a Jovian dinner. It is proposed to initiate a large class of candidates into the order in an impressive manner, and the management of the Electrical Trades Exposition is co-operating cordially in the effort to make the occasion a notable one.

Work on the Roosevelt Dam and Power House.—The Reclamation Service of the United States government reports that at the Roosevelt dam and power house on the Salt River project in Arizona satisfactory progress was made last month. The weir of the south spillway has been completed, and at the power house the gate hoist for the shutter and screen at the upper end of the 10-ft. penstock is completed. Satisfactory progress is also reported on the work at the Phœnix substation and in the installation of the Phœnix 2300-volt transmission line.

Baltimore Section, N. E. L. A.—At the annual election of the Baltimore Consolidated section of the National Electric Light Association, held last week in the physical laboratory of the Johns Hopkins University, the following officers for the ensuing year were elected: President, Mr. R. H. Tillman; vice-president, Mr. J. S. Cruikshank; secretary, Mr. A. W. Hawks; treasurer, Mr. D. C. Bruce. As previously noted, a course of lectures will be given during the quarter under the auspices of the section by Dr. J. B. Whitehead, Ph.D., of Johns Hopkins University.

Electric Club of Chicago.—Capt. O. D. Steele, of the Illinois National Guard (retired), was the speaker at the weekly luncheon of the Electric Club of Chicago on Dec. 21. His subject was "The Illinois National Guard," and in the course of an interesting talk he said that the law of 1902 placed the National Guard on the same footing as the regular army establishment. Enlistment in the militia teaches young men how to obey, respect for authority and how to command. The speaker urged his hearers to give their moral support to this important element in the national defense. Lieut. J. S. Button, of Schenectady, an officer in the National Guard of New York State, was called upon and among other things pointed out the advantage of the militia training in teaching a man how to handle a rifle. He made the interesting statement that there are two separate companies of the National Guard in Schenectady, and of the 170 men on the rolls of these companies probably 130 are employees of the General Electric Company. This company feels that the men in its employment are better men for belonging to the National Guard, and full pay is cheerfully given to the militiamen in its employment when absent on actual military duty as required by drill and camp life. Following Lieutenant Button, President F. P. Vose, of the Electric Club, gave an illuminating talk on the history of the United States Supreme Court and its chief justices, apropos of the recent appointments to that tribunal.

Locomotive Supplies Steam for Town Lighting.—During the reconstruction of the municipal street-lighting plant at Galesburg, Ill., which is being equipped with vertical boilers and a Lenz engine, a locomotive has been utilized to furnish steam for the existing engine-driven units. The locomotive was run onto the coal-bunker track just outside of the former boiler-room, and a pair of 2-in. pipe lines are taken from its steam dome to the power house header. A steam jet in the stack of the marooned locomotive takes the place of the usual exhaust nozzle for inducing forced draft in the firebox.

Growth of Commercial Edison Branch of N. E. L. A.—At the meeting of the Commonwealth Edison Branch (Chicago) of the National Electric Light Association held on Dec. 20 Mr. E. F. Smith, the chairman, announced that 231 new members had been received since the annual meeting on Nov. 1. As the membership at that time stood at 485, there are now over 700 members in the branch. It was announced that the branch will give an entertainment some time in February or March consisting of a first-class musical comedy, forming a background for a number of vaudeville sketches. The entire evening will be devoted to this performance, for which elaborate preparations are under way.

Electrical Echoes of Chicago Stockyard's Fire.—Fire Marshal James Horan, who, with twenty-two of his men, was killed in the disastrous fire in Morris' packing house at the Union Stockyards, Chicago, on Dec. 22, was a telegraph and telephone lineman as a young man before he entered the Fire Department. He had many friends among electrical men, and Mr. B. E. Sunny, president of the Chicago Telephone Company, called the first meeting to raise funds for the families of the firemen who were killed. The fire shocked the people of Chicago profoundly. It threw a great volume of emergency business on the telephone company during the busiest week of the year, and at about 10 or 11 o'clock in the morning calls were answered at the probable rate of 200,000 an hour. Every available operator and traffic operator was called into service.

Research Work at Massachusetts Institute of Technology.—Among work being conducted in the graduate department of the Massachusetts Institute of Technology, mostly under the direction of Professor Pender and Professor Wickenden, are researches relating to the effects of heat treatment on the magnetic qualities of silicon iron, to certain transient phenomena that may occur in long electric circuits, to the effect of high frequencies on the permeability of iron, to the effective resistance and reactance of steel rails when conveying alternating currents, to the selective action of spark-gap lightning arresters with respect to frequency, to the reflection of light from walls or ceilings, to the disruptive strength of rubber-insulated coatings on wires, etc. Certain of these researches are continuations of work started last year, and in each case will be carried on as may be convenient and needful to get knowledge of the phenomena under investigation.

ELECTRIC DEVELOPMENT ON THE SCHUYLKILL NAVIGATION CANAL.

Generating Station of the Philadelphia Hydro-Electric Company on the Canal Bank at Manayunk, Pa.

THE Philadelphia Hydro-Electric Company of Philadelphia, Pa., has just completed a small generating station on the canal of the Schuylkill Navigation Company just below the stations of the Pennsylvania and Philadelphia & Reading railroads at Manayunk, Pa. The station is on the south bank of the canal on land leased from the navigation company and is shown in Fig. 1. Coincident with the erection of the generating station it was necessary for the Schuylkill Navigation Company to enlarge the intake, feeder and canal section and to improve the dam and headworks at Flat Rock, one and one-half miles above the plant, so as to render the necessary water available at the station for its operation. The extra work, including that at the gate house and the upper locks and on the reconstructed timber dam at Flat Rock, necessitated an expenditure on the part of the navigation company of approximately $200,000. The improvements give enough water from the Schuylkill River to develop power at the station site without in any way interfering with the navigation of the river, one of the conditions under which the company is bound.

The station, near Green Lane, rests on solid rock, the foundation being 23 ft. deep. The structure is 140 ft. x 30 ft. and 44 ft. high and is built of steel, brick and reinforced concrete. The forebay as well as the spillway is a good example of concrete work and the foundations of the waterwheels, generators and gas engine are of the same material. Adjacent to the forebay and adjoining the producer room of the station is a large coal-storage yard with a siding of the Philadelphia & Reading Railroad running into it. Anthracite coal may also be brought to the station in canalboats. There is a small industrial track communicating with the producer room and the storage yard, the cars being elevated to the charging floor on a 2-ton plunger elevator.

The hydraulic equipment comprises four pairs of 36-in. water turbines built by the S. Morgan Smith Company, of York, Pa., each of which is housed in a separate concrete compartment and direct-connected to a 300-kw, three-phase,

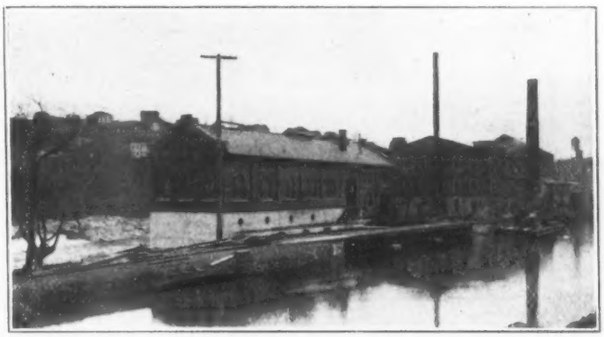


Fig. 1—Station of the Philadelphia Hydro-Electric Company at Manayunk, Pa.

60-cycle, 6600-volt Westinghouse generator running at 200 r.p.m. The speed is controlled by Lombard governors. Two belt-driven, vertical, direct-current generators, rated at 70 kw each, furnish the energy for excitation. In the basement below the generator room floor are the oil pumps, rheostats and belt drives from the main shaft of the water turbines to the exciter shafts. The water turbines are rated at 550 hp when operating under a 20-ft. head and develop 654 hp when operated under a 24-ft. head with full gate opening. A general view of the interior of the station, showing the arrangement of the main generators along the north wall, is given in Fig. 2, and Fig. 5 is a cross-sectional elevation of the plant.

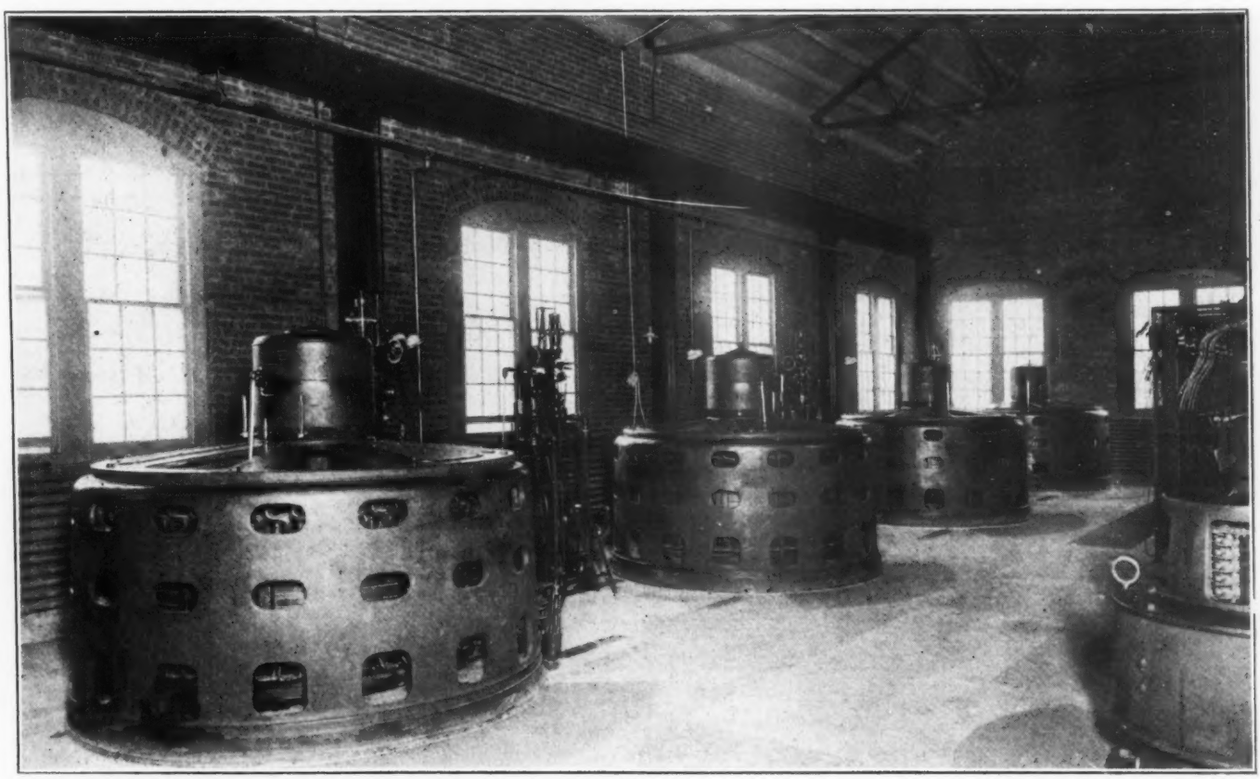


Fig. 2—Generator Room of the Philadelphia Hydro-Electric Company, Showing Water-Wheel Driven Units.

The water is taken from the canal under the railroad bridge into the forebay, one side of which serves as a spillway. The

usual arrangement of racks prevails. The wheels are set 20 ft. below mean water and approximately 4 ft. above tail water, so that with the draft tubes covered under normal river conditions a head of 24 ft. is available. In addition to the water-wheels there is a producer gas auxiliary equipment installed at the eastern end of the station, consisting of a three-cylinder Westinghouse engine rated at 270 hp and capable of a 10 per cent overload, and two R. D. Wood producers, each rated at 300 hp, and a scrubber. The gas producers burn buckwheat coal and with the scrubber are located in a separate compartment of the generating station, which also houses electrically and hydraulically driven blowers for the producers. The gas engine is direct-connected to a 150-kw, three-phase, 60-cycle, 6600-volt generator and has a 12½-kw exciter set belted to its shaft. The producer plant is said to be capable of generating a brake hp-hour on 1½ lb. of coal and may be operated independently or in multiple with the hydroelectric equipment.

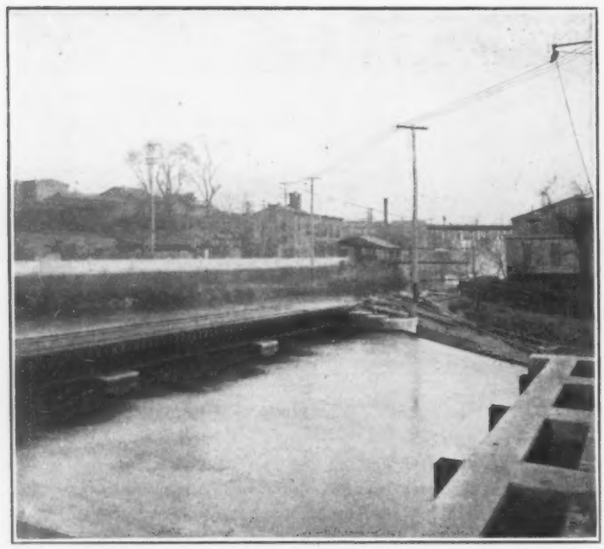


Fig. 3—Canal, Forebay, Spillway and Transmission Line.

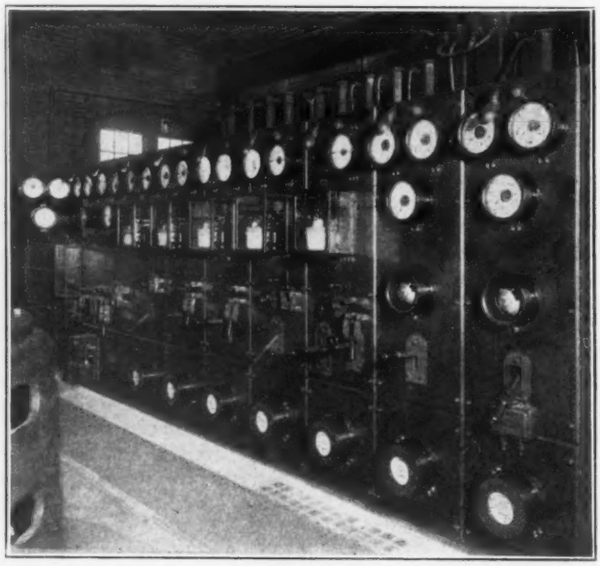


Fig. 4—Switchboard.

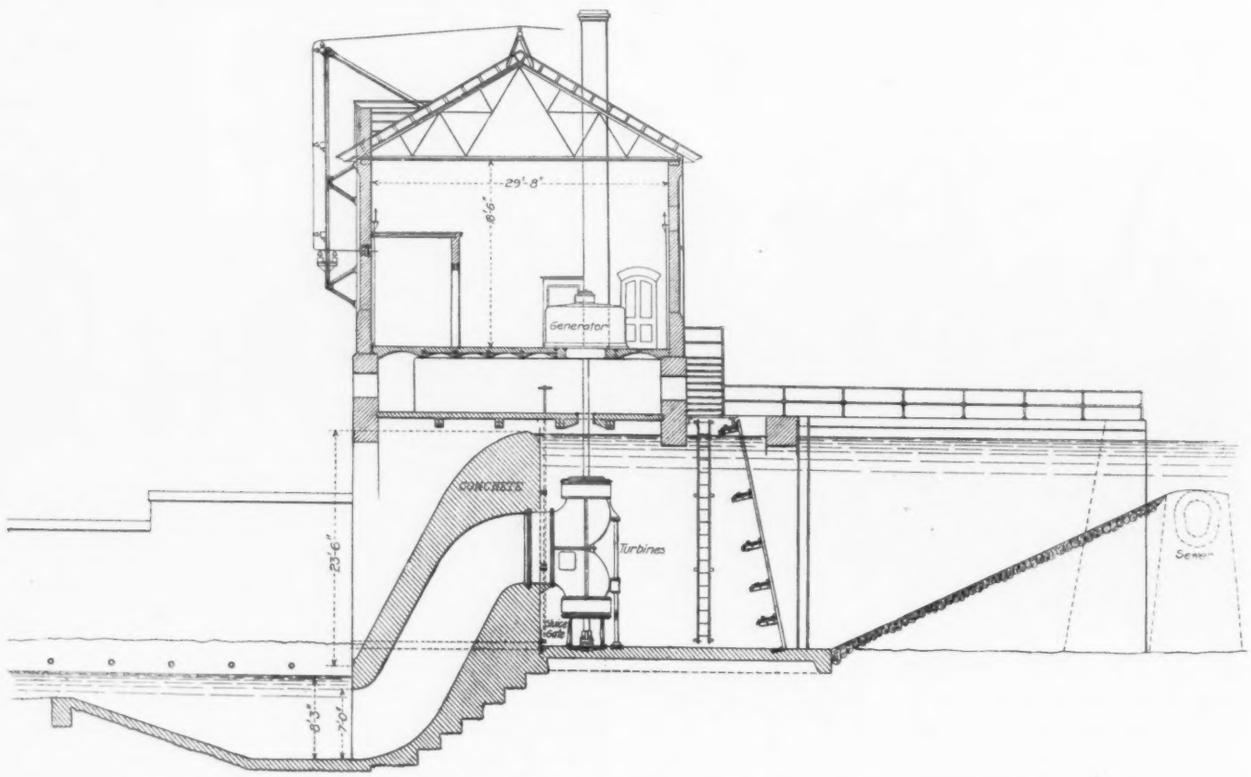


Fig. 5—Cross-Section Through Power House of the Philadelphia Hydro-Electric Company at Manayunk, Pa.

The generators, exciters and feeder circuits are controlled from a nine-panel, black slate switchboard fitted with the necessary measuring, indicating and recording instruments.

A single, three-phase, 6600-volt transmission line connects the generating station with a rotary-converter station of the Philadelphia Rapid Transit Company at Broad and Erie Streets, five miles away. The line is owned by the railway company and the substation contains nine 185-kw air-cooled transformers and three 500-kw rotary-converters. The entire output of the

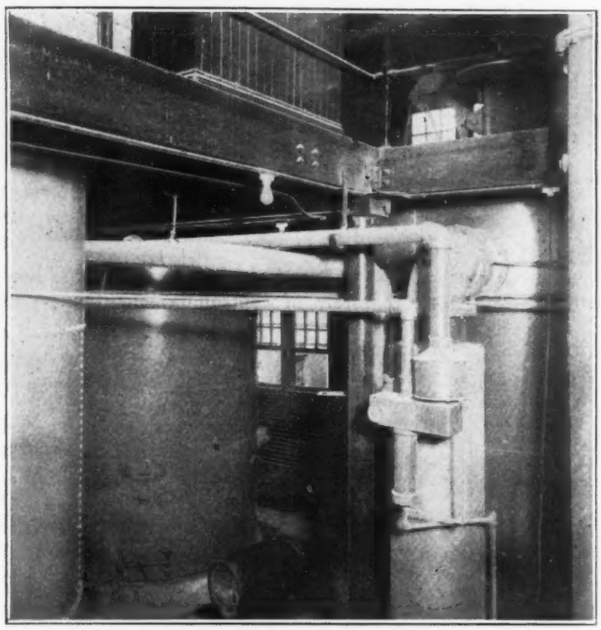


Fig. 6—Suction Gas Producers.

station is at present sold to the Philadelphia Rapid Transit Company.

The station was constructed by the American Pipe & Construction Company, of Philadelphia, under the supervision of Mr. J. W. Ledoux, who designed it. The officers of the Philadelphia Hydro-Electric Company are: Mr. Samuel L. Kent, of Lansdowne, Pa., president; Mr. Walter L. Rogers, of Riverton, N. J., secretary and treasurer, and Mr. A. B. Smedley, superintendent.

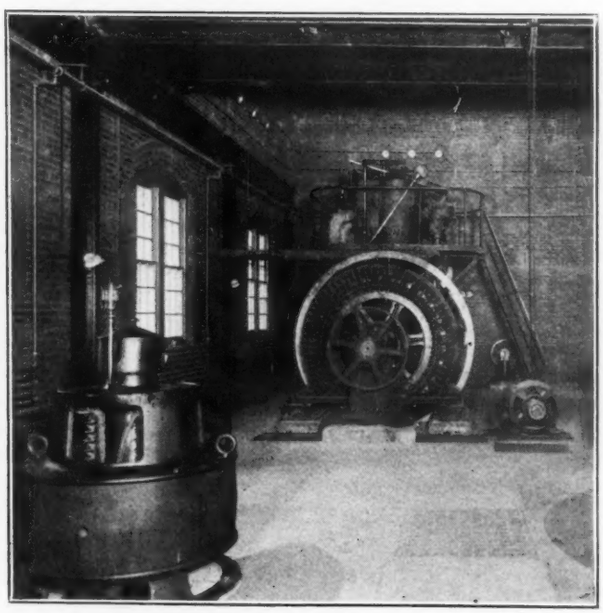


Fig. 7—Producer Gas Engine Equipment.

The office of the company is in the Witherspoon Building, Philadelphia, Pa.

ELECTRICAL PROPERTIES OF COMPOUND WIRES—II.

By Frank F. Fowle.

THE investigation of the inductance of a compound wire requires a knowledge of the distribution of the total current between the core and the shell. If I_1 and I_2 represent the proportionate core and shell currents, respectively, they can be expressed in the following terms:

$$I_1 = \frac{G_1}{G_{12}} = \frac{\frac{\pi r_1^2}{\rho_1}}{\frac{\pi r_1^2}{\rho_1} + \frac{\pi (r_2^2 - r_1^2)}{\rho_2}} \tag{32}$$

$$= \frac{\frac{r_1^2}{r_2^2}}{\frac{r_1^2}{r_2^2} + \left(1 - \frac{r_1^2}{r_2^2}\right)\left(\frac{\rho_1}{\rho_2}\right)} \tag{33}$$

$$= \frac{A_1}{A_1 + A_2\left(\frac{\rho_1}{\rho_2}\right)} \tag{34}$$

$$= \frac{n_1 s_2}{n_1 s_2 + n_2 s_1\left(\frac{\rho_1}{\rho_2}\right)} \tag{35}$$

and similarly,

$$I_2 = \frac{\left(1 - \frac{r_1^2}{r_2^2}\right)}{\left(\frac{r_1^2}{r_2^2}\right)\left(\frac{\rho_2}{\rho_1}\right) + \left(1 - \frac{r_1^2}{r_2^2}\right)} \tag{36}$$

$$= \frac{A_2}{A_1\left(\frac{\rho_2}{\rho_1}\right) + A_2} \tag{37}$$

$$= \frac{n_2 s_1}{n_1 s_2\left(\frac{\rho_2}{\rho_1}\right) + n_2 s_1} \tag{38}$$

The sum of I_1 and I_2 is always unity. Expressions (34) and (37) have been employed in computing the values of I_1 and I_2 for copper-clad and aluminum-clad wires, which appear in Table VI.

TABLE VI.—DISTRIBUTION OF CURRENT BETWEEN CORE AND SHELL, IN TERMS OF PROPORTIONAL SHELL AREA.

Ratio of Shell Cross-Section to Total Cross-Section.	PROPORTIONAL DISTRIBUTION OF CURRENT BETWEEN CORE AND SHELL.			
	Copper-Clad Steel.		Aluminum-Clad Steel.	
	Core.	Shell.	Core.	Shell.
0.00	1.000	0.000	1.000	0.000
0.10	0.519	0.481	0.636	0.364
0.20	0.324	0.676	0.437	0.563
0.30	0.219	0.781	0.312	0.688
0.40	0.153	0.847	0.225	0.775
0.50	0.107	0.893	0.162	0.838
0.60	0.074	0.926	0.115	0.885
0.70	0.049	0.951	0.077	0.923
0.80	0.029	0.971	0.046	0.954
0.90	0.013	0.987	0.021	0.979
1.00	0.000	1.000	0.000	1.000

Expressions (35) and (38) have been used to compute the proportions of I_1 and I_2 in terms of the proportion of shell by weight, given in Table VII.

Fig. 7 is plotted from Table VI and Fig. 8 from Table VII. It is notable that the proportion of current in the shell always exceeds the proportion of shell by either cross-section or weight, and the excess is considerable for small proportions of shell. The result of this distribution of current is to mini-

mize the effect of the high magnetic permeability of the core upon the total inductance.

TABLE VII.—DISTRIBUTION OF CURRENT BETWEEN CORE AND SHELL, IN TERMS OF PROPORTIONAL SHELL WEIGHT.

Ratio of Shell Weight to Total Weight.	PROPORTIONAL DISTRIBUTION OF CURRENT BETWEEN CORE AND SHELL.			
	Copper-Clad Steel.		Aluminum-Clad Steel.	
	Core.	Shell.	Core.	Shell.
0.00	1.000	0.000	1.000	0.000
0.10	0.551	0.449	0.373	0.627
0.20	0.353	0.647	0.209	0.791
0.30	0.241	0.759	0.134	0.866
0.40	0.170	0.830	0.090	0.910
0.50	0.120	0.880	0.062	0.938
0.60	0.083	0.917	0.042	0.958
0.70	0.055	0.945	0.028	0.972
0.80	0.033	0.967	0.016	0.984
0.90	0.015	0.985	0.007	0.993
1.00	0.000	1.000	0.000	1.000

The considerations up to this point have been based on wires of equal size. It may be useful to have expressions for the

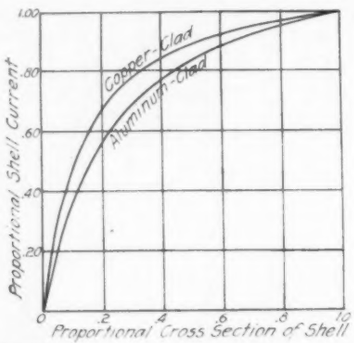


Fig. 7—Distribution of Current Between Core and Shell, in Terms of Proportional Shell Area.

comparative size and conductance in terms of equal weights. Proceeding upon this assumption:

$$W_{12} = \pi r_1^2 s_1 + \pi (r_2^2 - r_1^2) s_2 \tag{39}$$

$$W_c = \pi r_c^2 s_c \tag{40}$$

and

$$r_c^2 s_c = r_1^2 s_1 + (r_2^2 - r_1^2) s_2 \tag{41}$$

$$\frac{r_c^2}{r_2^2} = \frac{r_1^2}{r_2^2}\left(\frac{s_1}{s_c}\right) + \left(1 - \frac{r_1^2}{r_2^2}\right)\left(\frac{s_2}{s_c}\right) \tag{42}$$

$$= A_1\left(\frac{s_1}{s_c}\right) + A_2\left(\frac{s_2}{s_c}\right) \tag{43}$$

$$= A_2\left(\frac{s_2 - s_1}{s_c}\right) + \frac{s_1}{s_c} \tag{44}$$

$$= \frac{n_1 s_2\left(\frac{s_1}{s_c}\right) + n_2 s_1\left(\frac{s_2}{s_c}\right)}{n_1 s_2 + n_2 s_1} \tag{45}$$

$$= \frac{\left(\frac{s_1 s_2}{s_c}\right)}{n_1 s_2 + n_2 s_1} \tag{46}$$

Or finally the ratio of diameters is

$$\frac{r_2}{r_c} = \sqrt{\left[\frac{1}{A_2\left(\frac{s_2 - s_1}{s_c}\right) + \frac{s_1}{s_c}}\right]} \tag{47}$$

$$= \sqrt{\left[\frac{n_2 (s_1 - s_2) + s_2}{\left(\frac{s_1 s_2}{s_c}\right)}\right]} \tag{48}$$

When the weights are equal the ratio of conductances is

$$n = \frac{G_{12}}{G_c} = \frac{\frac{\pi r_1^2}{\rho_1} + \frac{\pi (r_2^2 - r_1^2)}{\rho_2}}{\frac{\pi r_c^2}{\rho_c}} \tag{49}$$

$$= \frac{r_1^2}{r_c^2}\left(\frac{\rho_c}{\rho_1}\right) + \frac{r_2^2 - r_1^2}{r_c^2}\left(\frac{\rho_c}{\rho_2}\right) \tag{50}$$

$$= \frac{r_2^2}{r_c^2}\left[\frac{r_1^2}{r_2^2}\left(\frac{\rho_c}{\rho_1}\right) + \left(1 - \frac{r_1^2}{r_2^2}\right)\left(\frac{\rho_c}{\rho_2}\right)\right] \tag{51}$$

$$= \frac{r_2^2}{r_c^2}\left[A_1\left(\frac{\rho_c}{\rho_1}\right) + A_2\left(\frac{\rho_c}{\rho_2}\right)\right] \tag{52}$$

$$= \frac{A_1\left(\frac{\rho_c}{\rho_1}\right) + A_2\left(\frac{\rho_c}{\rho_2}\right)}{A_1\left(\frac{s_1}{s_c}\right) + A_2\left(\frac{s_2}{s_c}\right)} \tag{53}$$

$$= \frac{n_1 s_2\left(\frac{\rho_c}{\rho_1}\right) + n_2 s_1\left(\frac{\rho_c}{\rho_2}\right)}{\left(\frac{s_1 s_2}{s_c}\right)} \tag{54}$$

The relations last given when the weights are equal are sometimes useful, but are rarely of controlling importance. The

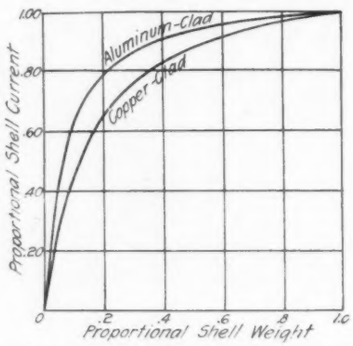


Fig. 8—Distribution of Current Between Core and Shell, in Terms of Proportional Shell Weight.

relations when the conductances are equal, however, are ordinarily very useful, and the following expressions develop the relative sizes and weights under this assumption. Primarily,

$$G_{12} = G_c \tag{55}$$

and hence

$$\frac{r_c^2}{\rho_c} = \frac{r_1^2}{\rho_1} + \frac{r_2^2 - r_1^2}{\rho^2} \tag{56}$$

$$\frac{r_c^2}{r_2^2} = \frac{r_1^2}{r_2^2}\left(\frac{\rho_c}{\rho_1}\right) + \left(1 - \frac{r_1^2}{r_2^2}\right)\left(\frac{\rho_c}{\rho_2}\right) \tag{57}$$

$$= A_1\left(\frac{\rho_c}{\rho_1}\right) + A_2\left(\frac{\rho_c}{\rho_2}\right) \tag{58}$$

Or

$$\frac{r_2}{r_c} = \sqrt{\left[\frac{1}{A_1\left(\frac{\rho_c}{\rho_1}\right) + A_2\left(\frac{\rho_c}{\rho_2}\right)}\right]} \tag{59}$$

Instead of the relative areas A_1 and A_2 the corresponding expressions in terms of relative weights and specific gravities can be taken from (8) and (9). The ratio of weights is,

$$\frac{W_{12}}{W_c} = \frac{r_1^2}{r_c^2}\left(\frac{s_1}{s_c}\right) + \frac{r_2^2 - r_1^2}{r_c^2}\left(\frac{s_2}{s_c}\right) \tag{60}$$

$$= \frac{A_1\left(\frac{s_1}{s_c}\right) + A_2\left(\frac{s_2}{s_c}\right)}{A_1\left(\frac{\rho_c}{\rho_1}\right) + A_2\left(\frac{\rho_c}{\rho_2}\right)} \tag{61}$$

$$= \frac{\left(\frac{s_1 s_2}{s_c}\right)}{n_1 s_2\left(\frac{\rho_c}{\rho_1}\right) + n_2 s_1\left(\frac{\rho_c}{\rho_2}\right)} \tag{62}$$

The foregoing relations as a whole are capable of numerous inversions of independent variable, of course, to suit the needs

of any particular consideration. These changes are too obvious to dwell upon. In leaving this part of the subject it may be noted that expressions (61) and (62) give the ratio of the mile-ohm of a compound wire to the mile-ohm of solid copper.

The method of deriving the inductance formula for solid homogeneous wires is well known; only that portion of it which gives the inductance internal to the wire will be considered here. The common formula is subject to certain limitations, but these will be taken up later.

Fundamentally the derivation rests upon the following statement by Maxwell*: "It appears, therefore, that the magnetic force at a given point due to a current arranged in cylindrical strata, the common axis of which is the axis of z, depends only on the total strength of the current in the strata which lie between the given point and the axis, and not on the distribution of the current among the different cylindrical strata."

Referring to the core shown in Fig. 9 the general expression for the inductance is

$$L_1 = \int_0^{r_1} \left(\frac{2\mu_1 r}{r_1^2}\right)\left(\frac{r^2}{r_1^2}\right)\delta r \qquad (63)$$

in which $\left(\frac{2\mu_1 r}{r_1^2}\right)$ is the field density at the end of a radius r and $\left(\frac{r^2}{r_1^2}\right)$ is the proportion of the total current inclosed within a circumference of radius r, the whole current being unity. The integration gives

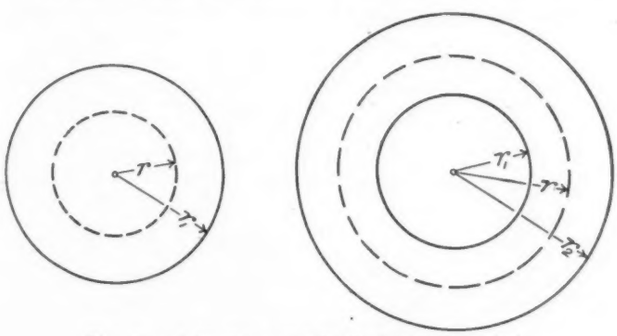
$$L_1 = \tfrac{1}{2}\mu_1, \qquad (64)$$

which is the total number of linkages between the unit current and the flux. But the core of a compound wire conducts only a fraction of a unit current which flows over the wire as a whole, and the final expression is, therefore,

$$L_1 = \tfrac{1}{2}\mu_1 I_1^2, \qquad (65)$$

where I_1 is given by expressions (32) to (35) or the complement of (36) to (38).

The flux density is not constant, but varies as a function of



Figs. 9 and 10—Core and Shell of Compound Wire.

the radius. At the axis of the core the density is zero and at the circumference it is $\left(\frac{2\mu I}{r_1}\right)$: other values lie between these limits, increasing with the distance from the axis toward the circumference. The total flux is given by the integral

$$\phi = I\int_0^{r_1}\left(\frac{2\mu_1 r}{r_1^2}\right)\delta r \qquad (66)$$

$$= \mu_1 I \qquad (67)$$

and the average density is

$$B = \frac{\mu_1 I}{r_1} \qquad (68)$$

This shows that the density increases uniformly from the axis to the circumference, and the average density is one-half the maximum. This deduction neglects the skin effect and assumes μ_1 to be independent of B, which is not true unless the $B-H$ curve within the limits of B is a straight line or sensibly so. The error is not likely to be large if the maximum value of B is very small: the actual value of B will be considered later.

The shell of a compound wire is shown in Fig. 10.

The total current inclosed within the radius r when the whole current in the wire is unity, referring to Fig. 10, is given by the expression

$$I_r = I_1 + \left(\frac{r^2 - r_1^2}{r_2^2 - r_1^2}\right)I_2 \qquad (69)$$

The field density at the extremity of the radius r is given by

$$B_r = \frac{2\mu_2 I_1}{r} + \frac{2\mu_2 (r^2 - r_1^2)\, I_2}{r\,(r_2^2 - r_1^2)} \qquad (70)$$

$$= \left(\frac{2\mu_2}{r}\right)I_r \qquad (71)$$

The inductance internal to the shell is the integrated product of expressions (69) and (70), or,

$$L_2 = \int_{r_1}^{r_2} \frac{2\mu_2 I^2 r}{r}\,\delta r \qquad (72)$$

$$= 2\mu_2 \int_{r_1}^{r_2} \left[I_1 + \left(\frac{r^2 - r_1^2}{r_2^2 - r_1^2}\right) I_2\ \right]^2 \frac{\delta r}{r} \qquad (73)$$

$$= 2\mu_2 \int_{r_1}^{r_2} \left[\frac{I_1^2}{r} + \frac{2 I_1 I_2 (r^2 - r_1^2)}{r\,(r_2^2 - r_1^2)} + \frac{(r^2 - r_1^2)^2 I_2^2}{r\,(r_2^2 - r_1^2)^2}\right]\delta r \qquad (74)$$

$$= \Big[2\mu_2 I_1^2 \log\frac{r_2}{r_1} + 2\mu_2 I_1 I_2 - \frac{4\mu_2 r_1^2 I_1 I_2}{r_2^2 - r_1^2}\log\frac{r_2}{r_1} + \frac{\mu_2 (r_2^4 - r_1^4)\, I_2^2}{2\,(r_2^2 - r_1^2)^2} - \frac{2\mu_2 r_1^2 I_2^2}{r_2^2 - r_1^2} + \frac{2\mu_2 r_1^4 I_2^2}{(r_2^2 - r_1^2)^2}\log\frac{r_2}{r_1}\Big] \qquad (75)$$

$$= \Big[2\mu_2 I_1 I_2 + \mu_2 I_2^2\left[\frac{r_2^2 + r_1^2}{2\,(r_2^2 - r_1^2)} - \frac{2 r_1^2}{r_2^2 - r_1^2}\right] + 2\mu_2\left[I_1 - \left(\frac{r_1^2}{r_2^2 - r_1^2}\right) I_2\ \right]\log\frac{r_2}{r_1}\Big] \qquad (76)$$

Therefore the total inductance internal to a compound wire is expressed as

$$L_{12} = L_1 + L_2$$

$$= \Big[\tfrac{1}{2}\mu_1 I_1^2 + 2\mu_2 I_1 I_2 + \tfrac{1}{2}\mu_2 I_2^2\left(1 - \frac{2 r_1^2}{r_2^2 - r_1^2}\right) + 2\mu_2\left(I_1 - \frac{r_1^2 I_2}{r_2^2 - r_1^2}\right)^2 \log\frac{r_2}{r_1}\Big] \qquad (77)$$

While this expression is unfortunately complicated and unwieldy, it can be reduced to the sum of two terms, of the form

$$L_{12} = a\mu_1 + b\mu_2, \qquad (78)$$

where a and b are constants for any particular wire. The following simplification will probably be helpful:

$$\frac{r_1^2}{r_2^2 - r_1^2} = \frac{1}{\frac{r_2^2}{r_1^2} - 1} = \frac{1}{\frac{1}{A_1} - 1} =$$

$$\frac{A_1}{1 - A_1} = \frac{A_1}{A_2} = \frac{n_1 s_2}{n_2 s_1} \qquad (79)$$

The values of the constants are then,

$$a = \tfrac{1}{2} I_1^2 \qquad (80)$$

*"Electricity and Magnetism," Vol. II, 3d ed., p. 316.

$$b = 2 I_1 I_2 + \tfrac{1}{2} I_2^2 \left(1 - \frac{2 n_1 s_2}{n_2 s_1}\right) + 2 \left(I_1 - \frac{n_1 s_2}{n_2 s_1} I_2\right)^2 \log \frac{r_2}{r_1} \qquad (81)$$

It appears to be convenient and practical to rate a compound wire by its conductance ratio to solid copper of equal size. In this case the following relations will be useful in computing inductance. The proportion of shell by weight will be

$$n_2 = \frac{s_2\left(\frac{\rho_c}{\rho_1} - n\right)}{s_1\left(n - \frac{\rho_c}{\rho_2}\right) + s_2\left(\frac{\rho_c}{\rho_1} - n\right)} \qquad (82)$$

and

$$A_1 = \frac{n - \frac{\rho_c}{\rho_2}}{\frac{\rho_c}{\rho_1} - \frac{\rho_c}{\rho_2}} \qquad (83)$$

$$\frac{r_2}{r_1} = \sqrt{\frac{1}{A_1}} = \sqrt{\frac{\frac{\rho_c}{\rho_1} - \frac{\rho_c}{\rho_2}}{n - \frac{\rho_c}{\rho_2}}} \qquad (84)$$

where n is the conductance ratio of the compound wire to a solid copper wire of equal size.

Compound wires of copper-clad steel are obtainable with conductance ratios of 20 per cent, 30 per cent, 40 per cent and 50 per cent, but ratios of 30 per cent and 40 per cent are now the standards commercially. The greatest difficulty in predetermining the properties of such wire arises in connection with the probable conductivity of the steel in the core. In general the conductivity of a steel of given composition becomes less as the tensile strength increases, resulting from rolling and drawing; but the process of annealing introduces modifications to this rule. In general, also, the conductivity of hard, tough steel is less than that of soft, mild steel. The grades of steel used in telegraph wires range in tensile strength from 58,000 lb. to 65,000 lb. per square inch, with conductance ratios ranging from 16 per cent to 14 per cent respectively. The grade of steel used in the core of copper-clad steel, in annealed rods, shows from actual test in one case a tensile strength of 61,500 lb.: the value runs up very considerably with the amount of drawing. It is not possible to draw steel wires through many reductions without annealing, because they become hard and brittle very rapidly and the conductivity diminishes. Copper-clad steel wires must be annealed during the drawing process, but not necessarily after each reduction. Hence, it might be possible, for example, to find the steel in a No. 10 wire softer and of higher conductivity than that in a No. 9 wire, if annealing took place between the reduction from No. 6 to No. 7 and again from No. 9 to No. 10. No fixed and invariable rule applies to the repetition of the annealing process, because of unavoidable variations of small magnitude in the composition and treatment of the steel. It should be observed, also, that the process of annealing steel hardens copper, as a result of which the conductivity of the latter will decrease progressively with the drawing. As a general proposition the conductivity of the steel core may be expected to diminish with the wire sizes, but not uniformly or without some exceptions.

Before considering the values of the constants in detail, it may be pointed out that the formula for the whole internal

TABLE VIII.—PROPORTIONAL SHELL WEIGHT AND RATIO OF SHELL TO CORE RADIUS, FOR COPPER-CLAD STEEL WIRES, IN TERMS OF CONDUCTANCE RATIOS.

$\frac{\rho_c}{\rho_1}$	n_2				$\frac{r_2}{r_1}$			
	$n=20\%$	$n=30\%$	$n=40\%$	$n=50\%$	$n=20\%$	$n=30\%$	$n=40\%$	$n=50\%$
0.15	0.0664	0.1961	0.322	0.443	1.031	1.102	1.190	1.304
0.14	0.0786	0.2064	0.330	0.450	1.037	1.108	1.197	1.312
0.13	0.0905	0.2165	0.339	0.457	1.043	1.115	1.204	1.319
0.12	0.1021	0.2263	0.347	0.464	1.049	1.121	1.211	1.327
0.11	0.1135	0.2362	0.355	0.470	1.055	1.128	1.218	1.334
0.10	0.1245	0.2453	0.363	0.476	1.061	1.134	1.225	1.342

TABLE IX.—PROPORTIONAL SHELL WEIGHT AND RATIO OF SHELL TO CORE RADIUS, FOR ALUMINUM-CLAD STEEL WIRES, IN TERMS OF CONDUCTANCE RATIOS.

$\frac{\rho_c}{\rho_1}$	n_2			$\frac{r_2}{r_1}$		
	$n=20\%$	$n=30\%$	$n=40\%$	$n=20\%$	$n=30\%$	$n=40\%$
0.15	0.0391	0.1380	0.2795	1.058	1.212	1.462
0.14	0.0465	0.1458	0.2875	1.069	1.225	1.477
0.13	0.0538	0.1535	0.2952	1.080	1.237	1.492
0.12	0.0611	0.1611	0.3029	1.091	1.250	1.508
0.11	0.0682	0.1686	0.3104	1.102	1.263	1.523
0.10	0.0752	0.1759	0.3177	1.113	1.275	1.537

TABLE X.—DISTRIBUTION OF CURRENT BETWEEN CORE AND SHELL, IN COPPER-CLAD STEEL WIRES.

$\frac{\rho_c}{\rho_1}$	$n=20\%$		$n=30\%$		$n=40\%$		$n=50\%$	
	I_1	I_2	I_1	I_2	I_1	I_2	I_1	I_2
0.15	0.706	0.294	0.412	0.588	0.264	0.736	0.177	0.823
0.14	0.651	0.349	0.380	0.620	0.244	0.756	0.163	0.837
0.13	0.598	0.402	0.349	0.651	0.224	0.776	0.149	0.851
0.12	0.546	0.454	0.318	0.682	0.204	0.796	0.136	0.864
0.11	0.494	0.506	0.288	0.712	0.185	0.815	0.124	0.876
0.10	0.444	0.556	0.259	0.741	0.167	0.833	0.111	0.889

TABLE XI.—DISTRIBUTION OF CURRENT BETWEEN CORE AND SHELL, IN ALUMINUM-CLAD STEEL WIRES.

$\frac{\rho_c}{\rho_1}$	$n=20\%$		$n=30\%$		$n=40\%$	
	I_1	I_2	I_1	I_2	I_1	I_2
0.15	0.670	0.330	0.340	0.660	0.175	0.825
0.14	0.612	0.388	0.311	0.689	0.160	0.840
0.13	0.557	0.443	0.283	0.717	0.146	0.854
0.12	0.504	0.496	0.256	0.744	0.132	0.868
0.11	0.453	0.547	0.230	0.770	0.119	0.881
0.10	0.404	0.596	0.205	0.795	0.106	0.894

TABLE XII.—INTERNAL INDUCTANCE OF COPPER-CLAD STEEL WIRES, WHEN THE CONDUCTANCE RATIO OF STEEL TO COPPER IS 12 PER CENT.

Value of n.	Formula for Internal Inductance. In c.g.s. Units.
20%	$L_{12} = 0.149\mu_1 + 0.0646\mu_2$
30%	$L_{12} = 0.0506\mu_1 + 0.102\mu_2$
40%	$L_{12} = 0.0208\mu_1 + 0.147\mu_2$
50%	$L_{12} = 0.00925\mu_1 + 0.193\mu_2$

TABLE XIII.—INTERNAL INDUCTANCE OF ALUMINUM-CLAD STEEL WIRES, WHEN THE CONDUCTANCE RATIO OF STEEL TO ALUMINUM IS 19.35 PER CENT.

Value of n.	Formula for Internal Inductance. In c.g.s. Units.
20%	$L_{12} = 0.127\mu_1 + 0.0990\mu_2$
30%	$L_{12} = 0.0328\mu_1 + 0.1816\mu_2$
40%	$L_{12} = 0.00871\mu_1 + 0.2624\mu_2$

inductance as given in (77) is entirely consistent when either I_2 or I_1 becomes zero. In the first case,

$$\left.\begin{array}{l}\text{when } I_2 = 0 \\ L_{12} = L_1 = \frac{1}{2}\mu_1\end{array}\right\} \quad (85)$$

which is the result obtained for a solid homogeneous wire. In the second case,

when $I_1 = 0$

$$L_{12} = L_2 = \frac{1}{2}\mu_2\left[\frac{r_2^4 - 3r_1^2}{r_2^2 - r_1^2} + \frac{4r_1^2}{(r_2^2 - r_1^2)^2}\log\frac{r_2}{r_1}\right] \quad (86)$$

which is Maxwell's expression for the inductance of a hollow tubular conductor. The inductance of a compound wire is not directly the sum of two such terms as (85) and (86), but is more complicated in form and contains an additional term.

In order to furnish a ready basis for calculating the inductance, expressions (82) and (84) have been employed in calculating a table of values of the proportional shell weight and the ratios of the radii, for copper-clad and aluminum-clad steel, in terms of the conductance ratios. Table VIII gives the results for copper-clad and Table IX for aluminum-clad.

The proportional distribution of current between core and shell, which is also needed in the inductance calculation, is given in Tables X and XI.

These values recorded in Tables VIII to XI make it possible to carry out a calculation for the total internal inductance of copper-clad or aluminum-clad wires, the conductance ratios of which to solid hard-drawn copper range from 20 per cent to 50 per cent, when the conductance ratio of steel to copper ranges from 10 per cent to 15 per cent. Such calculations, carried through for all the cases when the conductance ratio of steel to copper is 12 per cent, are shown in Table XII. The results so obtained will give the inductance when the values of μ are known.

The value of μ_2 is unity for copper-clad and aluminum-clad wires. The value of μ_1 will be the subject of further consideration. The values of the constants given in Table XII show clearly the diminishing effect of the steel core as the proportion of copper to steel increases. Similar constants are given for aluminum-clad wire in Table XIII.

The constants given in Table XIII correspond to conductance ratios of 12 per cent for steel to copper and 62 per cent for aluminum to copper.

The inductance expressed by these formulas is given in c.g.s. electromagnetic units. In order to express the inductance in henries per 1000 ft. or per mile, the constants a and b should be multiplied by the quantities: 0.0000-3048 for henries per 1000 ft., 0.0001609 for henries per mile.

The considerations up to this point have been wholly theoretical, so as to develop the theoretical side of the subject. A comparison of the results thus obtained with the results of actual measurements for copper-clad steel will be taken up in a subsequent issue.

TURBINES OF INCREASED CAPACITY AT NIAGARA FALLS, ONT.

THE Canadian Niagara Power Company has just placed in commercial operation a water turbine of special interest in that it was designed by the company itself and actually does what turbine builders both here and in Europe said could not be done under the conditions obtaining at Niagara Falls, Ontario. Fig. 1 herewith shows elevations of units Nos. 5 and 6, and gives a general idea of the appearance of both the old and new types of turbines.

The plant of the Canadian Niagara Power Company was originally designed for an ultimate installation of eleven 10,000-hp units and the wheelpit was completed with inlets, draft tubes and machinery supports suitable for turbines of that size. Five 10,000-hp units were installed and have been in successful operation since 1906. The first three turbines were designed and built by Messrs. Escher, Wyss & Company, in Zurich, Switzerland, and the fourth and fifth turbines were manufactured from the same designs by the I. P. Morris Company, in Philadelphia, Pa. The general hydraulic construction of the plant is very similar to that of the Niagara Falls Power Company on the American side, which is so well known to all engineers as to require no detailed description. The station differs principally from that of the American company in that three-phase currents instead of two-phase currents are generated and

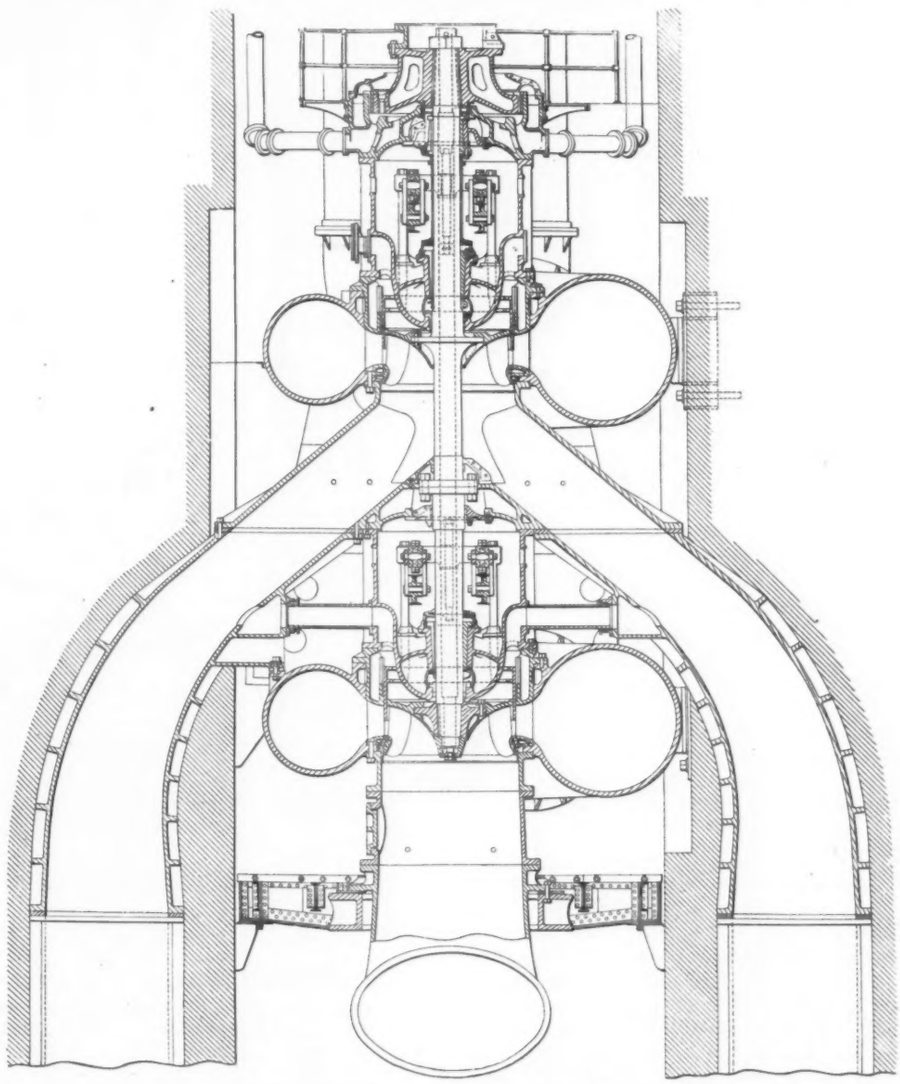


Fig. 1—Cross-Section of New Turbine.

the units are rated at 10,000-hp, whereas those in the American stations are rated at 5000 hp.

The turbines are of the Francis type, inward discharge, with draft tubes led to the bottom of the wheelpit. To maintain the level of the water in the wheelpit at a sufficient height at all loads to cover the mouths of the draft tubes a regulation gate is installed at the end of the wheelpit. The latter is operated by a direct-current motor rated at 85-hp. The weight of the rotating machinery is carried by an oil-thrust bearing under the working drawings in complete detail were made in the office of the company at Niagara Falls, N. Y.

The contract for the construction and delivery of the new turbine and lower penstock was given to the Bethlehem Steel Company, of South Bethlehem, Pa., which built the machine in all its parts. The complete turbine and shaft were erected during the past summer by employees of the power company, and the three-phase, 25-cycle, 12,000-volt generator was built and installed by the Canadian Westinghouse Company, Ltd. The gov-

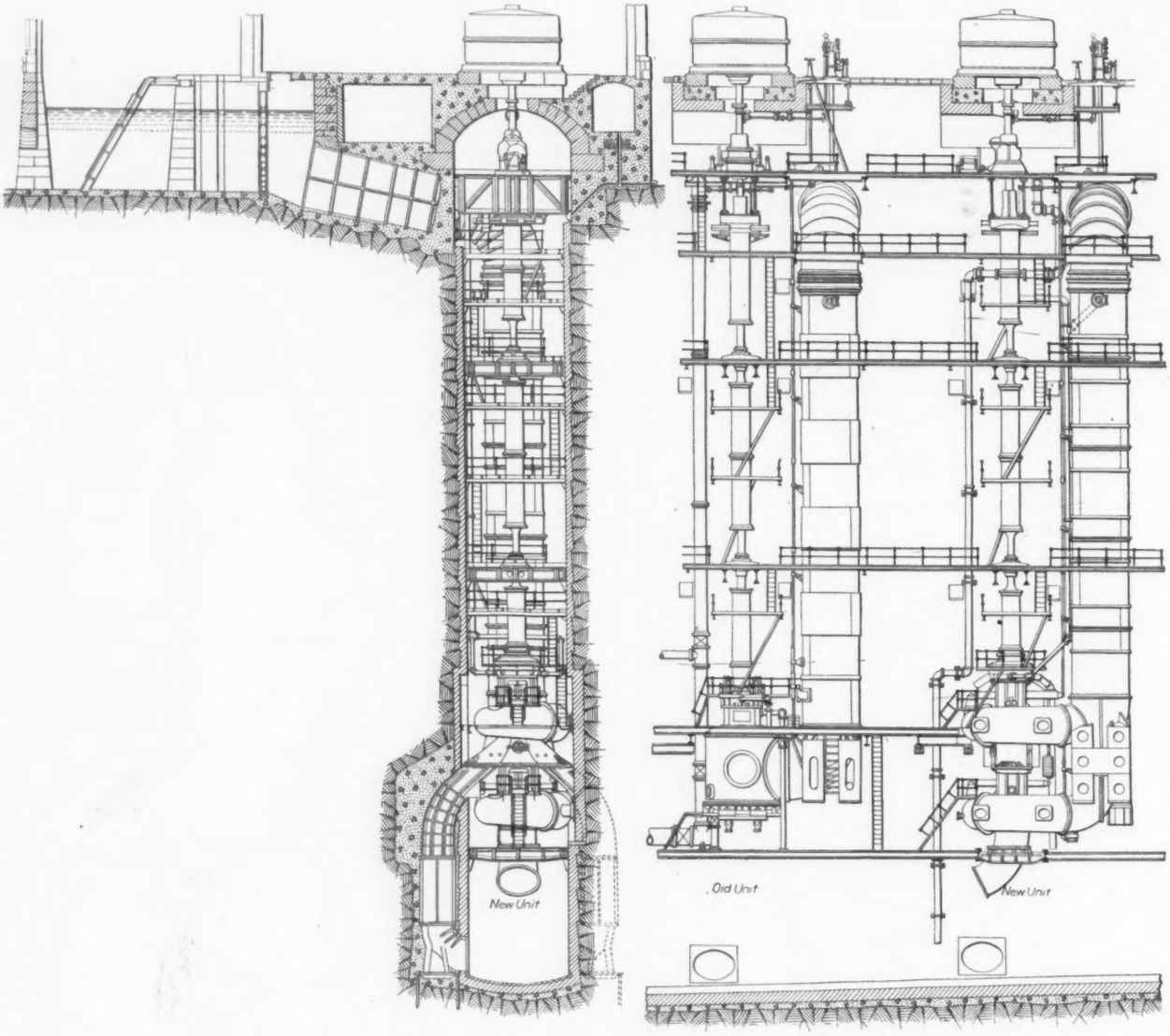


Fig. 2—Cross-Section Elevation of Old and New Water-Turbine Units in Station of Canadian Niagara Power Company.

generators and also by a hydraulic piston at the bottom of the wheel. The available head is approximately 135 ft.

A study of the hydraulic conditions in the tunnel and wheelpit after the completion of the first five turbines indicated that each of the remaining units could profitably be made to give 25 per cent greater capacity than those first installed. Proposals were, therefore, sought in this country and in Europe for the design and construction of a turbine that would deliver 12,500 hp at the switchboard. Some of the manufacturing companies refused to undertake the work, while others submitted plans of turbines which could not, under the existing conditions, deliver the power called for except at very low efficiency. Mr. C. C. Egbert, mechanical engineer of the Niagara Falls Power Company, then undertook to design a turbine which would deliver 12,500 hp at reasonably good efficiency, and ernor is of the modified Escher, Wyss & Company design, part of which was built by the power company and the remainder by the designers in Zurich, Switzerland. The riveted steel penstock was built by the John Inglis Company, Ltd., of Toronto, Canada, and erected by the power company. The high-pressure oil pumps for supplying the oil to the governor and to the thrust bearing were also designed by Mr. Egbert and built in the machine shop of the power company, so that taken all in all the water turbine and its auxiliary apparatus are strictly a product of the Niagara Falls Power Company.

The new turbine, which, as stated before, has just been placed in commercial operation, has shown a most gratifying performance. When operating under a head of 133 ft. it delivers 12,800 hp at the switchboard, and under normal running conditions the head and consequently the output of the turbine will

be somewhat greater. The head was purposely reduced to 133 ft. by means of the tail-water regulating gate at the lower end of the wheelpit so that the head during the test would approximate that which will exist when the ultimate development is reached. The indications are that the efficiency of the unit is equal to or better than that of the turbines of the older type. The cost of construction as compared with that of the older

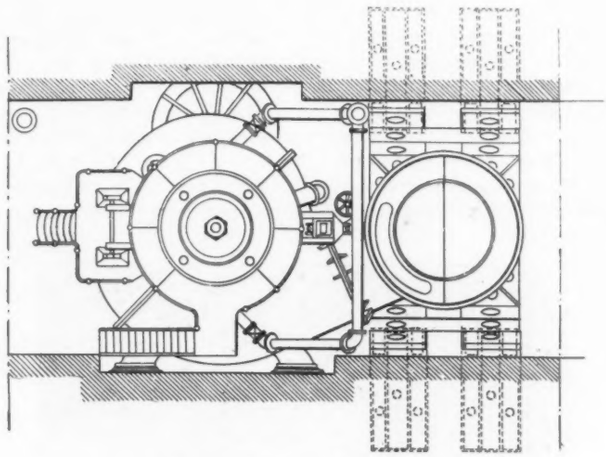


Fig. 3—Plan View of New Unit.

turbines is greatly in favor of the new design. Moreover, by making its own designs it has been possible for the power company to purchase in a broader market and thereby obtain better prices and quicker deliveries. The unit will shortly be given a very thorough test, when its efficiencies at various loads will be determined and its operating characteristics compared with those of the older units.

HYDROELECTRIC DEVELOPMENT OF THE CALGARY POWER COMPANY.

The generating station of the Calgary Power Company, now under construction at the Horseshoe Falls on the Bow River, near Kananaskis Siding, on the main line of the Canadian Pacific Railroad and about forty-five miles west of Calgary, Alberta, Canada, is rapidly nearing completion. A concrete dam is being built across the river and four steel penstocks will run from the forebay to the generating station, where a head of 72 ft. is available. Three of the penstocks are now under construction and the dam and the generating station are almost complete. The immediate equipment for the generating station has been ordered and a large amount of it is now on the site. It consists of two 2500-kva, 60-cycle, 12,000-volt, three-phase, horizontal, waterwheel-type generators having a speed of 300 r.p.m. and one 4000-kva generator running at 225 r.p.m. with characteristics similar to the other two machines.

Two 175-kw, 125-volt, turbine-driven exciters have also been provided. The three main generators and the two exciters are being built by the Canadian General Electric Company, Ltd., and the water turbines for the two smaller units and the two exciters are being built by Messrs. Jens Orten Boving, of London, England. The water turbine to drive the 4000-kva unit will be built by the Wellman-Seaver-Morgan Company, of Cleveland, Ohio. Space has been left in the station for the installation of a second 4000-kva unit and a motor-driven exciter.

The transformer equipment at the generating station will eventually consist of four 3000-kva, 60-cycle, three-phase, water-cooled units, stepping up the potential from 12,000 volts to 55,000 volts. Three of these transformers are now being built in the works of the Canadian Westinghouse Company, Ltd., which will also furnish the three-phase transformers for the Calgary terminal station from which energy will be distributed at 600 volts, 2400 volts and 12,000 volts. A single circuit, 55-000-volt transmission line about fifty miles long, on wooden poles, connects the Calgary terminal station to the generating station, and a duplicate line will be constructed in the near future. The line conductor is a No. 0 stranded aluminum wire and the line is protected from lightning by a ¼-in., seven-strand, galvanized-iron cable running along the top of the poles and grounded at every second pole. A telephone circuit is also carried below the main transmission wires.

The entire switching equipment for the generating station and terminal station will be furnished by the Canadian Westinghouse Company, Ltd. The generator voltage was fixed at 12,000 volts to permit of the transmission of 3000 hp at the generator voltage to the Western Canada Cement & Coal Company's cement mill at Exshaw, Alberta, which lies about eight miles from the generating station. The substation at the Exshaw mill and the transmission line thereto had been completed, so that the cement mill will be operated entirely from energy transmitted from the generating station as soon as the latter is ready for operation, which will be in the early spring. Contracts have been closed with the City of Calgary and with the Alberta Portland Cement Company at Calgary, which will add from 3000 hp to 4000 hp additional to the load on the plant.

The office of the Calgary Power Company is in Montreal, Quebec. The president is Mr. H. S. Holt and the managing director Mr. Cecil B. Smith. Messrs. Smith, Kerry & Chace, of Toronto, are the engineers in charge of the design and construction of the system

Central Station

Management, Policies and Commercial Methods

CHRISTMAS OFFER TO BROOKLYN CHURCHES.

Appreciating the danger incurred by the use of lighted candles on Christmas trees in church festivals during the Yuletide season and with the object of illustrating the safety and beauty of the modern method of electrical Christmas-tree decoration, the Edison Electric Illuminating Company of Brooklyn made an offer to loan to any church in Brooklyn using its service a complete Christmas-tree lighting outfit consisting of vari-colored miniature lamps. Outfits for any tree, however large, were provided. The only stipulation applying to the loan of the outfits was that they were to be used between Dec. 20 and Dec. 30, and that requests must be addressed to the sales department and signed by an officer of the church or Sunday school desiring to be served. Owing to the demands for the sets by sale to the company's customers for home use the number loaned was limited to the first fifty requests received. Needless to state, the invitation met with a hearty response and the fifty sets to be loaned were bid for within a day or two after the public announcement appeared in the daily papers.

A RATE WITH AN "ACTIVE-LAMP" READINESS-TO-SERVE CHARGE.

The Chippewa Valley Railway, Light & Power Company which furnishes hydroelectric energy from its Eau Claire and Cedar Falls water-power plants to consumers in Eau Claire, Menomonie, and Chippewa Falls, Wis., and Red Wing, Minn., makes use of an original rate for lighting service which comprises an "active-lamp" readiness-to-serve charge added to an energy-consuming element proportional to the kw-hours registered by the meter.

For residence lighting the rate is 15 cents per month for each "active" connected 50-watt unit, plus 3 cents per kw-hour for all energy consumed by the entire installation, whether active or inactive lamps. Active lamps are defined as those used in main halls, main stairways, parlors, libraries, dens, music-rooms, conservatories and butlers' pantries, besides one 50-watt unit on the second floor. Non-active lamps are those used on porches and in vestibules, lavatories, out-buildings, stables, back halls, back stairways and all other rooms not expressly mentioned under the classification of active lamps. One non-active portable reading lamp is also allowed in rooms where active lamps are installed. The 50-watt graphitized-filament lamp is taken as the unit of consumption, and tungsten and other lamps are compared with it on a watt basis, no unit being computed, however, as less than three-fifths of 50 watts, or 30 watts, on which the charge is 9 cents. All carbon units of 8 cp or less are also rated at 30 watts, on which the readiness-to-serve charge is 9 cents per month in addition to the energy consumed.

It will be noted that the "active" readiness-to-serve schedule does not include fan motors or electric heating appliances, so that the cost of operating this class of apparatus is virtually only 3 cents per kw-hour for the actual energy consumed without demand charges. This attractive low rate has been the means of introducing a large number of electric irons, cooking utensils, etc., onto the lines of the company.

The rate for hotels, clubs and boarding houses is the same as that for private residences except that lamps in dining-rooms, buffets, bars, bowling-alleys, billiard-rooms, card-rooms, barber-shops, lobbies, main halls, corridors and lavatories are all considered as active lamps.

For commercial lighting the rate is 15 cents per month for each connected 50-watt unit (without classification as to whether active or inactive), plus 3 cents per kw-hour for all energy consumed, except where 10 per cent of the total connected rating is used for window-display or advertising purposes, in which case these display lamps are considered inactive and are subject only to a consumption charge. The maximum charge for this class of business in no case exceeds 6 cents.

The minimum residence-lighting charge is $1 per month and for commercial houses $1.50. Customers having less than five 50-watt units are served under a flat-rate schedule, unless the company installs a meter by preference. Under this flat rate the charge is 30 cents per 50-watt unit per month in residences and 50 cents in commercial installations, the minimum bill being 90 cents a month.

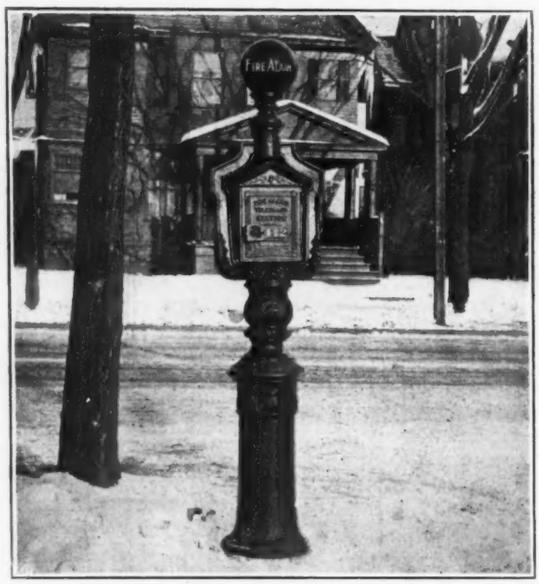
Competition from other illuminants is provided against by a clause in the rate schedule which insures that in all residences depending exclusively on electricity for illumination not more than 75 per cent of the total connected lamps may be considered as active, while in houses having auxiliary lighting service all lamps are deemed active and a readiness-to-serve charge is required for each.

This rate schedule has been in use since May, 1910, and its results are reported to be highly successful. Inspections of customers' installations are made every six months for the purpose of noting changes in lamps, etc., but practically no intentional frauds have been discovered in switching lamps from "active" to "inactive" sockets.

LIGHTED FIRE-ALARM BOXES IN ROCHESTER, NEW YORK

At a recent conflagration in the City of Rochester, N. Y., it was brought out that the man who discovered the blaze at night made a conscientious attempt to turn in an alarm, but in his bewilderment and excitement could not remember where the fire-alarm box was located. As a result of this delay the fire gained considerable headway and caused serious loss. The superintendent of the Rochester Railway & Light Company, reading the account in the daily papers and being, like all Rochesterians, envious for the reputation of the Flower City, immediately set about to devise a plan for making fire-alarm boxes so conspicuous at night that a similar delay from a like cause would not obtain.

The scheme as planned by the company consists of lighting every fire-alarm box with an incandescent lamp inclosed in an



Electrically Lighted Fire-Alarm Box.

outer red globe. It was approved by the city engineer, who also became interested in the scheme, and incidentally gives the Rochester Railway & Light Company a gross income of $7,500 a year.

At present the 300 fire-alarm boxes of the city are thus lighted. No change was made in the fire-alarm posts, a special fitting at the top being equipped with a shade holder and a 40-watt, clear-bulb, tungsten lamp over which is a red globe with the words "Fire Alarm" etched in it. The lighting circuit to the post is run underground either from the underground system or from a pole line, the leads in the latter case passing down the pole in conduit to the fire-alarm post. Where the lighting circuits are on the opposite side of the street the circuit is placed underground in an iron pipe, a single conductor being used for one lead and the pipe itself for the other lead. In this way the extra cost of a double conductor is saved and the small transformers—for all the lamps receive energy from an overhead or underground 16-volt, 40-watt transformer connected to the constant-current arc lighting circuits—are effectually grounded. The small transformers are in most cases set in the manholes adjacent to the fire-alarm posts.

In bringing a circuit from a transformer on a pole line it is usually possible to drive the conduit across the street without opening the latter, thus not only saving the expense of digging, but causing no inconvenience to traffic.

Now every fire-alarm box in Rochester is easily discernible at night for a great distance. When looking down a main thoroughfare the red lights thrust themselves into view like so many danger signs along a brightly lighted roadway, and the plan has given complete satisfaction ever since its installation a few months ago.

A SUGGESTIVE GAS CAMPAIGN AT CHICAGO.

Any unusual and successful activity on the part of a gas company should interest central-station men, not only as indicating the competition to be expected from enterprising gas producers, but also as suggesting similar methods for the expansion of their own business. Such is the "amber light" campaign now being conducted at Chicago by the People's Gas Light & Coke Company, which has the monopoly of the local gas business. Like other gas concerns this company has been feeling the inroads of the tungsten lamps, and while the so-called Humphrey "gas arcs" have helped it to hold a good share of its store lighting, these are out of the question for residence work. The use of inverted gas mantles had been tried persistently, but the fixtures in common use were all designed for upward mantles and the mongrel appearance of the resulting combination offset whatever little talking points the inverted type might have. At best this inverted mantle seemed to be only a misfit rearrangement of the more familiar type, lacking the novelty and the talking points which have made the tungsten lamps so effective for the electric light people.

In this emergency the gas company at Chicago turned to the chemically colored mantles lately offered by its ally, the Welsbach Company, selecting one which gives an amber tint to the light instead of the greenish hue of the more familiar gas mantles. With it they planned to offer a self-lighting (by-pass) burner, a glass chimney, a shade holder and an opal dome shade, all for $1.60. Knowing that they could not compete with the tungsten lamps for whiteness of the light, they began by using quarter-page advertisements in the leading daily papers to expound the amber-colored light as "taking the place of the amber-colored glasses which oculists so often recommend." Then they sent out 150 solicitors, each wearing a cap marked "Gas Inspector" and carrying ten of these outfits. Going from house to house, the solicitors offered on behalf of the gas company to show the new lamp right in the user's own house without expense to the latter. Of course, the outfit as thus attached by them showed up far better than any flat flame burner; also better than most of the mantle lamps already in service, as it had a higher grade of mantle than the average and this was brand new, while the mantles already on the fixtures might have lost anywhere from 10 per cent to 70 per cent of their light-giving power. Few gas users know how much a mantle loses in candle-power during service, nor even how much its efficiency depends on its being adjusted for the right pressure, which adjustment would have to be made many times a day to match the widely varying gas pressures found in most parts of Chicago. Of course, the solicitor could easily adjust the air supply to match the pressure while showing the new lamp, leaving any old burners out of adjustment, and hence he could hardly fail to make a good impression.

If the customer wanted the new light the solicitor attached and adjusted the lamps, collecting no money, but getting the customer's signature to an order under which the charge for the outfits would be distributed over several future gas bills. The charge per outfit installed is $1.60, of which 30 cents goes to the solicitor; and as the lights speak for themselves (compared with run-down gas lamps) many of the men sell 250 a month. Where a customer fears that the cost of mantle renewals will be too high the solicitor offers a maintenance contract under which the gas company agrees to inspect the lights every month (or oftener if notified) and to replace any defective or worn-out mantles and chimneys. This is done for a monthly charge added to the gas bill and ranging from 10 cents per lamp, where five or more of the new lights are installed, to 25 cents for a single light.

To make this sales campaign still more effective Mr. T. R. Beebe, of the gas company, arranged to have fortnightly meetings held in rotation at the fifteen different stores in which mantles, gas stoves, etc., are sold by his corporation. Each of these meetings is attended by all of the men connected with the store at which it is held and by the managers of the fourteen other stores. The time is devoted to discussing the devices offered, the methods of installing them and the arguments to be used and met in making sales. Since starting these meetings some two months ago the efficiency of the salesmen is said to have improved so much that the fortnightly sessions are now to be extended so as to include various other devices which will increase the consumption of gas.

For the central-station manager this method of basing a sales campaign upon one particular type of lamp and fixture should be suggestive, as also the plan of holding frequent meetings for the exchange of experiences. The same sort of house-to-house campaign would seem feasible for the electric light men, with certain differences decidedly in their favor. They will not need to tint their lamps with a strong color, for they can offer an almost white light in the tungsten lamp. Neither will they be handicapped by that dissatisfaction which comes from offering a gas lamp adjusted to give a high candle-power when installed during the day, but not giving perhaps half as much light with the changed pressure during the evening. Nor need they try to explain away the blackening of the ceilings above the old lamps or the devitalizing of the air by consuming its oxygen in the gas burners. Hence central stations have nothing to fear from gas campaigns of this sort, but they can profit by the example, and in some cities by an early house-to-house canvass offering tungsten incandescent lamps on a similar easy-payment plan may steal a march on the gas companies, which are just beginning to realize that they must fight hard to hold their own against electrical competition.

WAUPACA STREET-LIGHTING CONTROVERSY.

A controversy over arc street lighting has arisen at Waupaca, Wis., which is of considerable interest to the central-station industry and in many respects is similar to the famous Colorado Springs lighting controversy, which was arbitrated before experts in 1907. A hearing was held before a special agent of the Wisconsin Railroad and Public Service Commission at Waupaca, Wis., Dec. 15 and 16.

The main points at issue in the case appear to be whether a 6.6-amp inclosed series alternating-current arc lamp is the equivalent of a 6-amp or 9.6-amp series open-arc lamp for practical street-lighting purposes; also, whether after the city has accepted the inclosed lamps for a number of years it is legally estopped from claiming any rebate or damages. There were several modifying circumstances in the main points at issue as just outlined, which modifications will be explained in what follows.

It appears from the testimony given at the hearing at Waupaca that the City of Waupaca in 1903 entered into a contract with the Waupaca Electric Light & Railway Company to light the streets for a period of ten years with lamps of nominal 2000 cp. The company was using at the time of the contract the old-style open-arc lamp, but testimony varied as to whether the current was 9 amp or 9.6 amp. This was the same lamp that had been used under previous contracts and had been described in a similar way. In 1903 the company changed its street-lighting system, using series inclosed alternating-current lamps of G. I. manufacture, with G. I. regulators rated for 6 amp to 7 amp. These lamps were, when installed, adjusted, according to all testimony, at 6.6 amp. This condition obtained until about March, 1910, when, after some controversy between the City

Council and the company as to the value of the present street light, the company increased the current to 7 amp.

It appears from the testimony that the change of street lamps was talked over at various times with members of the City Council by Mr. Irving P. Lord, general manager of the company. No formal authorization of the change was made, however. For a period after the change the bills of the company for lighting were receipted with an indorsement to the effect that the city waived none of its rights under the contract in paying these bills. Except for this the city authorities apparently took no definite action until about a year ago, when the Mayor and some members of the City Council, having been led to believe from various sources that the lamps being furnished by the company were not the equals of the old ones, began an investigation with the result that an inspector of the Wisconsin Public Service Commission was sent to Waupaca and also made a brief investigation. The inspector reported upon the history of the case as nearly as he could obtain it by conversation with various parties, and called attention to the Colorado Springs decision and to the 1908 report of the National Electric Light Association committee on street lighting, in both of which the 7.5-amp inclosed arc is rated as the equivalent of the old 9.6-amp open arc and the 6.6-amp arc is placed in a lower classification.

Offers were made for compromise and arbitration by both sides, but apparently without result, and the city refused to pay the company's bills. This resulted in a suit being started by the company to force payment of these bills. It was finally agreed by the company and the city to refer the whole matter to the Wisconsin commission for decision and arbitration.

The hearing, which was held at Waupaca Dec. 15 and 16, was conducted by a special agent of the commission, Mr. Samuel T. Walker, evidence being taken in shorthand for review by the commission at Madison. The hearing was of considerable interest, it being the first time a question of this kind had been brought before the Wisconsin commission. Mr. William T. Fisher, of Merrill, Wis., acted as attorney for the city and Mr. Parks, of Stevens Point, Wis., for the company. The expert on behalf of the city was Mr. James R. Cravath, consulting engineer, Chicago, and on behalf of the company, Mr. W. D'A. Ryan, of the General Electric Company. The testimony was taken under oath as in court proceedings, but many of the court formalities were omitted in order to save time and get quickly at the fact. For example, cross-examination of experts by each other was permitted on technical matters, a proceeding almost unheard of in courts and one at which many lawyers would doubtless hold up their hands in horror, but the result was undoubtedly much saving in time and useless questioning.

The city granted at the outset that the old open lamps fulfilled the specifications of the contract. On the technical points involved the experts were nearly in accord. Both agreed that street illuminants should be rated largely according to the illumination obtained from them at considerable distances from the lamp. In other words, for arc lamps the candle-power between 3 deg. and 5 deg. below the horizontal was agreed upon as being the fairest comparative test. Both experts cited the 1908 report of the committee on street lighting of the National Electric Light Association. This report gives an arbitrary value of 3.5 to the 6.6-amp series alternating-current inclosed-arc lamp as against a value of 4 to 9.6-amp direct-current open-arc lamp. Mr. Ryan, who conducted the tests upon which this rating was based, stated, however, that the actual difference found in the tests was not quite as great as the ratio of 3.5 to 4. The ratio of 3.5 to 4 had been adopted because he considered it undesirable to have too many general classifications. He gave it as his opinion that with lamps properly maintained and operated a 7-amp inclosed lamp would be the equivalent of the old 9.6-amp open arc. He also emphasized the greater steadiness, lower intrinsic brilliancy and better light distribution inherent in the inclosed arc.

In testifying for the city Mr. Cravath cited various tests and opinions to the effect that the 6.6-amp inclosed arc is not the equivalent of the old 9.6-amp open arc, and that if a substitution is made, the 7.5-amp inclosed-arc lamp should be used. He cited the decision in the Colorado Springs case where 20 per cent was awarded as the difference between the two lamps, and summed up the testimony of various experts in that case on this point. He also cited the tests carried on for the National Electric Light Association committee by Prof. C. P. Matthews on the photometric values of arc lamps, and reported to the association at its 1902 convention as showing that the real difference between the two lamps was known as far back as 1902. He also gave his own estimates and cited the opinions of other experts on the saving in cost of trimming and carbons by the introduction of the inclosed-arc lamp. He also gave the results of watt tests taken at the terminals of thirteent different street lamps in Waupaca Dec. 9, 1910, which showed an average of 415 watts. This, he said, indicated that the lamps were not being maintained in a condition to give the light whch should be expected of a 7-amp or even a 6.6-amp lamp. He also gave results of a limited number of candle-power tests made on the same lamps the same night, which also indicated that the lamps were not being properly maintained. These tests were made with the photometer about ten times as far away from the lamp as the height of the lamp to conform to National Electric Light Association recommendations. He did not consider the test extensive enough to be of conclusive value as an average, but in general it indicated bad conditions. The three lamps tested averaged respectively 197 cp, 113 cp and 140 cp. The maximum observed candle-power was 336 and the minimum observed 78.

Mr. I. P. Lord, general manager of the lighting company, and Mr. Francis Raymond, of Chicago, who sold the inclosed-arc lamp equipment, both testified that the 6.6-amp inclosed lamp was being generally sold and installed as an equivalent to the 9.6-amp open arc at the time this change was made.

The case will probably not be decided for some time. Such controversies are unfortunate, and the lesson for electric lighting companies in them is that contracts for street lighting should be as definite as possible, and if not based on illumination performance should be for some specified type of lamp. Eventually all illuminants should have a primary rating based on mean spherical candle-power representing the total light output, with perhaps a derived secondary rating to conform to the type of lamp or conditions of illumination.

Wiring and Illumination

TEMPORARY STREET-LIGHTING CIRCUITS.

By W. S. Quimby.

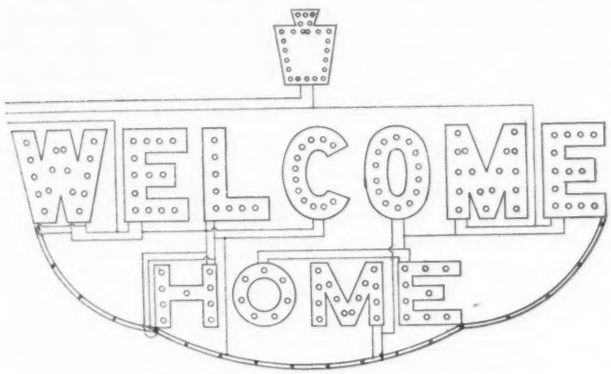
During the recent "Home Coming Week" celebration held at Phœnixville, Pa., effective use was made of special electric signs and street arches. A "Welcome" sign was suspended across one street and festoons of incandescent lamps were placed along both sides of the streets along several blocks in the center of the town. All of the lamp sockets used were of the weatherproof style, placed 2 ft. apart on the conductors, the whole being carried on a steel messenger wire. The wire for the spans, which varied from 50 ft. to 200 ft., was stretched out along the ground, all of the twists, kinks and crosses being removed while it was in this position. As the spans were made ready, they were lifted into position and tied in under the trolley span wires several feet from the poles. A block and tackle was used to tighten up the spans.

At street crossings and at three intermediate places span wires were stretched across the street from the top of the trolley poles and above the trolley wire; on these wires were placed strings of lamps forming small arches.

As the primary leads in the alternating circuits in the part of town where the temporary circuits were installed were already overloaded it became necessary to utilize energy from a 500-

volt motor circuit. The temporary lighting circuits were arranged for multiple-series distribution, the lamps being grouped in banks of five, each bank containing sixty lamps.

In the "Welcome Home" sign use was made of 28-in. letters in the first word and 16-in. letters in the last. The letters were made of tin completely incasing the sockets, which were joined in multiple. The number of lamps in the letters were such that the circuits of two or three letters had to be placed in parallel in order to secure banks of equal size, the extra lamps



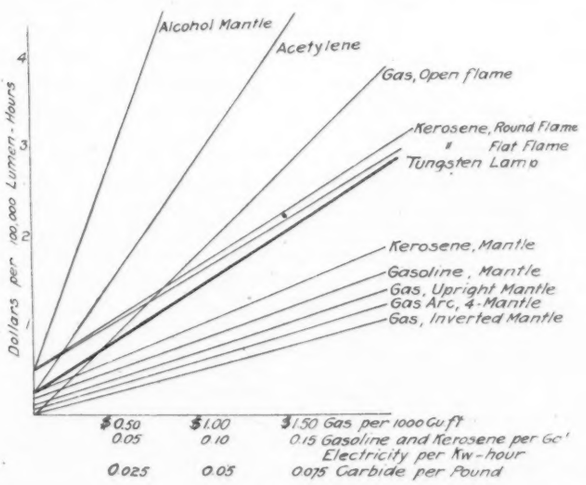
Electric Street Sign.

needed being festooned beneath the sign. A keystone outlined with lamps surmounted the "Welcome Home" sign.

The total number of lamps used in the temporary circuit was 2365, all of which were 16 cp with the exception of 475, which were 8 cp. The latter lamps were arranged in a separate multiple-series circuit. The special lighting was in service for thirty-two hours and consumed 4276 kw-hours. The entire display cost less than $600.

COMPARATIVE COSTS OF PRODUCING LIGHT WITH DIFFERENT ILLUMINANTS.

At a meeting of the Chicago Section of the Illuminating Engineering Society, held on Dec. 15, Prof. J. M. Bryant and Mr. H. G. Hake, of the School of Electrical Engineering, University of Illinois, presented a paper on "Comparative Costs of Producing Light with Different Illuminants," embodying the



Comparative Cost of Total Light Produced by Various Illuminants.

results of investigation and research work carried on at the University Experiment Station at Urbana, Ill.

The data presented dealt with thirty-one different kinds of electric lamps and with ten principal kinds of combustive illuminants. The results of the investigation for the electric lamps were arranged for comparison in a table, reproduced herewith, showing the watts consumed by each illuminant as measured at its terminals, the total lumens produced by it, the kw-hours consumed for each 100,000 lumen-hours, and the cost of 100,000 lumen-hours at a rate of 10 cents per kw-hour. Part of the determinations, said Mr. Hake, were made in the university laboratory, but in some instances values given by manufacturers and others were taken, where it was possible to check these carefully. The thirty-one illuminants compared are listed as follows in the order of their efficiency:

COST OF PRODUCING LIGHT WITH VARIOUS ILLUMINANTS.

	Amperes.	Terminal Watts.	Lumens.	Kw-hours for 100,000 Lumen-hours.	Total Cost per 100,000 Lumen-hours, at 10 cts. per Kw-hour.
Regenerative d.-c. series arc	5.5	385	11,670	3.3	0.339
Regenerative d.-c. multiple arc	5.5	605	11,670	5.18	0.527
Magnetite d.-c. series arc	6.6	528	7,370	7.16	0.729
Flame arc, d.-c., inclined electrodes	10.0	550	8,640	6.37	0.837
Mercury arc, d.-c., multiple	3.5	385	4,400	15.92	0.89
Flame arc, d.-c., inclined electrodes	8.0	440	6,140	7.16	0.966
Flame arc, d.-c., vertical electrodes	8.0	440	6,140	7.16	0.966
Luminous arc, d.-c., multiple	6.6	726	7,370	9.85	0.988
Open arc, d.-c., series	9.6	480	5,025	9.55	1.079
Magnetite arc, d.-c., series	4.0	320	2,870	11.15	1.13
Flame arc, a.-c., vert. electrodes	10.0	467	5,340	8.75	1.275
Flame arc, a.-c., inclined electrodes	10.0	467	5,340	8.75	1.275
Open arc, d.-c., series	6.6	325	2,920	11.15	1.305
Tungsten, series	6.6	75	626	12.0	1.384
Flame arc, a.-c., inclined electrodes	8.0	374	3,910	9.55	1.405
Inclosed arc, d.-c., series	6.6	475	3,315	14.32	1.459
Luminous arc, d.-c., multiple	4.0	440	2,870	15.32	1.547
Tungsten, multiple	0.545	60	475	12.6	1.55
Nernst, a.-c., 3-glower	1.87	414	2,160	19.2	1.88
Nernst, d.-c., 3-glower	1.87	414	2,160	19.2	1.90
Inclosed arc, a.-c., series	7.5	480	2,410	19.9	2.05
Inclosed arc, a.-c., series	6.6	425	2,020	21.3	2.193
Tantalum, d.-c., multiple	.....	40	199	21.1	2.34
Tantalum, a.-c., multiple	.....	40	199	21.1	2.504
Carbon, 3.1 w.p.c., multiple	.....	49.6	166	29.9	3.24
Carbon, 3.5 w.p.c., series	6.6	210	626	33.6	3.47
Carbon, 3.5 w.p.c., multiple	.....	56	166	33.7	3.50
Inclosed arc, d.-c., multiple	5.0	550	1,535	35.8	3.66
Inclosed arc, d.-c., multiple	3.5	385	1,030	37.4	3.84
Inclosed arc, a.-c., multiple	6.0	430	1,124	38.3	3.94
Inclosed arc, a.-c., multiple	4.0	285	688	41.4	4.265

The values given for the cost of operation of the thirty-one illuminants included, besides the cost of electrical energy, the average outlay for maintenance, renewal and cleaning, but did not cover the fixed charges of investment, etc. The flame arcs tested were photometered with their opal globes in place as furnished by the manufacturers. In each case of the original measurements the lamps used were virtually new or newly trimmed, the tests being made as soon as stable conditions were reached and allowance made for the efficiency to be expected during average life conditions.

Mr. Hake also exhibited curves showing the cost of ten principal flame illuminants, using gas, gasoline, kerosene, acetylene and alcohol as fuels at various prices per unit of fuel consumed. For convenience the cost curve of the tungsten electric incandescent lamp was also plotted, as shown in the accompanying diagram. The speaker remarked that the electrical man must find other arguments than low cost of operation to urge even the tungsten lamp against the competitive illuminants. The accompanying diagram of costs, as prepared by Mr. Hake, makes it possible to compare the costs of producing a given quantity of light by any illuminant at given rates of cost of fuel or electricity.

Mr. Ward Harrison, of the National Electric Lamp Association, objected to a comparison of the tungsten lamp with flame illuminants under the conditions given, declaring that the percentage of utilization by reflectors of the light produced with gas, for example, 25 per cent, is much below that possible to utilize with tungsten lamps, 50 per cent to 60 per cent. The initial candle-power of gas-mantle lamps also fails rapidly, due to dust, shocks, minor cracks and chemical changes, with use, showing a sustained value of only 60 per cent or 70 per cent

of that initially recorded, as in the tests of new mantles quoted. The pilot flame of a "gas arc" fixture, he said, constitutes a heavy fixed cost, consuming from 25 per cent to 30 per cent of the amount of gas actually burned in the mantle burners during a year's operation. The relative cost of lighting, with gas at $1 per 1000 cu. ft. and electricity at 10 cents a kw-hour, will be found to vary less than 10 per cent on each side of the same amount when tungsten lamps and gas mantles are used.

Mr. C. M. Axford, Chicago, suggested that a comparison of the effective lumens available on the working plane, rather than the total light flux produced, would be a fairer contrast of the illuminants. On account of the reflecting power of walls and ceilings the relative values given in the paper would apply more correctly, he thought, to interior than to outdoor lighting. Mr. A. L. Eustice, Chicago, observed that the observational data submitted with the results in the paper were too meager to admit of a discussion bringing out much of importance in the comparison of light sources tested. Since practically new units were used in each instance, he said, certain illuminants suffered by comparison with others whose sustained efficiency throughout their life was lower.

Prof. J. M. Bryant closed the discussion by calling attention to the advantages of conducting the tests so as to take account of the total light flux produced by each illuminant, permitting those investigators who want special questions answered to make use of the total flux results in determining the amount of light available for special distributions. Matters of flicker and color differences, said Professor Bryant, made the comparison of some illuminants difficult.

RECENT TELEPHONE PATENTS.

TRANSMITTERS.

A pneumatically operated transmitter is one of the latest instruments invented. The flat diaphragm secured at its edges and attached at its middle to a movable electrode of a microphonic button has long been known to the art. In the above-mentioned instrument, patented by John Sparks, of Kimberly, Cal., a balanced piston valve occupies the position usually given up to the button, while this latter is made double and mounted at any convenient point. Flexible tubes carry the air supply to the piston valve and from it to two air chambers one side of each of which is one diaphragm of the electrical part of the transmitter. When the main instrument is spoken to the diaphragm vibrates, carrying the balanced piston with it and admitting and exhausting air pressure from the pneumatic chambers. It is intended to handle much greater currents in this than in the ordinary transmitter and thus obtain increased volume.

No less than seven patents of recent issue refer to modifications of the transmitter by Mr. Felix Gottschalk, of New York City, all covering transmitters from which the usual flaring mouthpiece is omitted. In general, the patents concern means of concentrating the received tones upon the microphone button through the shape or treatment of the diaphragm. One of the patents describes a transmitter with a large aperture in the front and a disk-shaped diaphragm free at its periphery and secured to the front electrode at its middle. The rim of the disk flares outwardly rapidly at the edge and overlaps and becomes parallel to the front face of transmitter, which it just clears. A round-headed button piece is arranged to screw down over the projecting end of the electrode stud, thus covering it and inclosing the metal lock nuts ordinarily left exposed to the breath of the user.

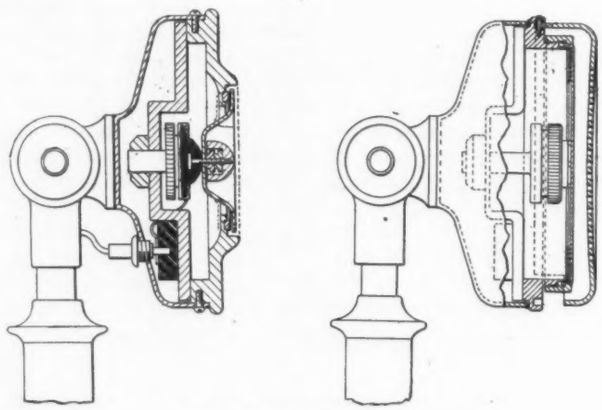
A second transmitter uses a flat diaphragm secured at the edges and exposed to voice waves, the connection between the electrode and diaphragm being made by means of an auxiliary disk or cone-shaped diaphragm bearing against the back of the flat diaphragm. The auxiliary diaphragm is so formed that it presents a flat surface to the rear face of the flat one rather than an edge.

In another a spider replaces the above auxiliary diaphragm and the flat diaphragm is flanged and put under radial tension by a clamping ring bearing upon the flange. The tensioning device is really akin to that of an ordinary drum.

Another patent describes a sheet-metal guard piece with circular perforated front and radial arms extending back to engage the heads of the usual rim screws of the transmitter. The transmitter is provided with the disk-shaped diaphragm and the guard protects it.

As another variation the cone diaphragm is mounted outside the usual flat diaphragm, the cone reaching well up into the usual aperture, from which the rubber mouthpiece has been removed. A ring with inwardly overhanging flanges is then screwed in so that the edge of the cone is not exposed, though free from contact. In another, the face piece of the transmitter casing is made with the overhanging flange at the aperture.

In the last a drum-head diaphragm is used under tension and a perforated box-like sheet-metal cover is arranged to protect the diaphragm. The edge of the cover slips into an angular groove of equal radius made in the face of the transmitter. Pins concealed in the groove engage registering angle slots in the cover piece, so that this latter is secured by a slight angular rotation. The accompanying engravings show two of the above transmitters which may be taken as examples of the two types.



Sound-Reproducing Device.

Mr. G. R. Taylor, of San Francisco, has also patented a transmitter having a special mouthpiece. The scheme may be understood by considering a transmitter of the usual design with a considerable section of the mouthpiece cut away, leaving the small end and the flare end in position. A metal frame is then fitted so as to hold these parts in their proper relative positions. An open wall mouthpiece is thus provided, the free space being greater as the metal frame is lightened.

A very sensitive receiver is the goal sought by Mr. H. R. Stuart, of Wheeling, for use with very weak currents, such as telephone currents. He uses a double receiver with a single diaphragm between the opposing pole-faces of the two co-operating magnetic systems. These are of the double-pole type, the permanent magnets being flanged rings which clamp the diaphragm between them and which are magnetized with consequent poles. Radial pole-pieces project inwardly from the polar points and these carry, perpendicularly to the diaphragm, the polar extensions with the magnetizing coils.

MISCELLANEOUS APPARATUS.

A telephone repeater of the tele-microphone type forms the subject of the patent issued to Mr. S. L. Campbell, of Prairie City, Ore. The claims relate to structural details of the parts.

A departure in receiver design is shown in the invention of Mr. H. R. Stuart, of Newark, N. J. He uses a pair of solenoids which rock an armature in response to received telephone currents. An arm attached to the armature vibrates the diaphragm in turn, being connected to it by a tension wire. A sound tube leads from either face of the diaphragm.

LETTERS TO THE EDITOR.

Scientific Abstractions in Relation to Scientific Realities.

To the Editor of Electrical World:

SIR:—I have read with interest the comments of Mr. G. T. Hanchett on "wattless power" in your issue of Dec. 15, 1910 (pp. 1430-1431).

Mr. Hanchett's suggestion that we call "reactions" all the excess currents and voltages which appear in circuits, and forever divorce from their names the words "power" and "watt," represents a formula which it is more easy to enunciate than to apply. It is true, perhaps, as a generalization. We can say iron rust is a chemical compound. Such a generalization, though useful for the purpose of general classification, does not tell us much about the nature of the thing, i. e., the "how" and the "why" and the "wherefore" of its "thusness," as one might put it. To get deeper into the nature of iron rust we have to invoke the aid of chemical or physical facts and theories. The facts must, necessarily, be real; the theories need not necessarily be so. Theories are merely psychological expedients whereby facts may be assembled, assorted and explained. A given assemblage of facts may serve as the basis for *several* "correct" and "consistent" theories. Mr. Hanchett's desire to deal with realities and to eschew abstractions is laudable enough as long as we are not interested in "causation." The moment we want to inquire into causes and reasons we find it desirable, and oftentimes we find it necessary, to use imagination.

Mr. Hanchett, as a scientific and philosophic thinker, knows this very well. He knows that science is full of fiction, and that some of the greatest figments of the imagination are to be found, not in romantic, but in scientific, literature. We accept and use them without hesitation, even though they are more impossible of physical realization and of belief than Munchausen's tales. Take a very well known case as an illustration. In mechanics we deal with *masses* as if they were concentrated at a mathematical *point*, and with *forces* as if they acted along mathematical *lines*. Can we conceive of anything more impossible of realization than the condensation of a finite mass having a finite volume into a mass having zero volume without any loss of mass? Could we conceive of a more difficult "miracle" for the Almighty to perform? Yet this miracle has been performed, without a hitch, millions of times, since the days of Newton and Galileo—the first two "wizards" who performed it. This physical impossibility has come to be so "real" and so "natural" to us that we should be surprised if anybody questioned it. What is the reason for our implicit faith in this figment of imagination? Simply this—it has never clashed with the facts, but, on the contrary, has helped us countless times, with unerring precision, to assemble, assort and even *discover* facts. Contrast, in the mind, the ease with which one can grasp the physical significance of a *moment of inertia*, for instance, by the aid of that figment with the difficulty of doing so *without* it. Think how difficult a study analytical mechanics would be if it were not for the very helpful assistance of the "fictions" underlying it. The polygon of forces and substantially the whole of vector geometry are based upon figments of the imagination. Yet, has any instrument or process ever been devised by the human mind which is more wonderful and more powerful for the purposes of analyzing, of combining, decomposing or resolving forces than the polygon of force—vectors? We could not do without it anywhere when we have to deal with forces of composite or complex nature. I can scarcely believe that Mr. Hanchett wants to banish it from alternating-current analysis in spite of his peremptory tone.

If he is willing to admit the existence of current-*reactions* and voltage-*reactions*, he ought to be willing to concede the possibility, at least, of reaction-*currents* and reaction-*voltages*. This is a case where "turn-about is fair play" in more senses than one. Moreover, Mr. Hanchett would find it very difficult indeed to formulate the modernized or extended Ohm's law, to which he refers, without having proper terms to designate the various force-factors of the different kinds of energy which necessarily have to be taken into account, including the energy which is *stored*, *restored* or *dissipated* by means of three distinct kinds of reactions, namely, kinetic or acceleration reactions, potentials or elastic reactions, and damping, attenuating or resistance reactions.

Many of the "reactions" introduced in alternating-current analysis may be mere figments of imagination, whose physical existence, by themselves, could not be demonstrated. That circumstance does not prevent them from being very useful quantities, the same as our fictitious mass of zero-volume. The one strong point in their favor is that the use of these *seemingly* artificial, spurious, unreal "reactions" does not lead us away from the correct *end-results*. We may be flying through empty or imaginary space in using them, as we do when we use masses of zero-volume; but, as we always "land" safely on *terra firma* at the end of the trip, we need not be alarmed. The end justifies the means. *Finis coronat opus.*

So, let us not strain at little "gnats" like "reaction-voltage" or "reaction-current" when we swallow, without hesitation, some "whoppers" among the "camels" of scientific theory. These things are not more fictitious than many others which we all accept without hesitation. Personally I do not consider these "gnats" fictitious at all. On the contrary, I consider them both real and useful. Because the values dealt with practically are "resultants" of a sum of vectors which have various magnitudes and directions we are not justified in denying the existence of the "component" vectors, as a whole, or of any of them in particular. It is not at all necessary that every component should "materialize" separately and individually to prove its existence. It is enough that the existence of some of them has been proved. The existence of the rest follows as a matter of necessity, just as the third side of a triangle "follows" when two of its sides and the included angle are known.

If Mr. Hanchett wants to find some really serious cases of fiction in science, as consolation for such trifling misdeeds, let him read Poincaré's "Science and Hypothesis."

In regard to Ohm's law, it is as wrong to give Ohm too much credit as too little. There is no evidence that Ohm considered anything but the "damping" or resistance reactions. Even Kirchhof, who came after Ohm and certainly went far more deeply into the subject, fell short himself of the generalization which now makes Ohm's law for steady currents a particular case of a law applicable to variable currents and involving all three kinds of "reactions." As a matter of fact, that generalization was apparently unsuspected even as recently as twenty-five years ago. It has been "in the air" only since men like Rayleigh, Heaviside and Mascart began to devote attention to it; and it has been definitely recognized only in the last ten years, after being further elaborated and refined by some of our own contemporaries, chief among whom is Dr. M. I. Pupin.

New York. C. O. MAILLOUX.

Historical Electrical Apparatus for National Museum.

To the Editor of Electrical World:

SIR:—I have picked up and delivered to the National Museum, Smithsonian Institution, Washington, D. C., a few specimens of early electrical apparatus. This collection contains some very valuable historical specimens and should be added to largely in the line of specimens of early electric-lighting material. The early form of Bradley pressure indicator is very much desired, and there should be one or more of these in existence. This indicator was the invention of Mr. Charles S. Bradley and was first used at the old Pearl Street station. It was nearly 1 ft. square and stood on three leveling screws with fixture and scale at the front, and represented the original form of the Bradley-Howell lamp indicator which was the

standard engine-room voltmeter of the General Edison Company for many years.

The balance used for weighing zinc plates for the Edison meter is another desirable item which some of the old Edison central stations should be able and willing to contribute. The earliest form of porcelain cut-out seems to have disappeared from the collections examined. There are many other items which would be of great historical interest and which could be secured at the present time if those in position would take them out from attics and cellars to send to the undersigned or direct to the National Museum. It would have been a piece of great good fortune if any man had done for the development of electrical apparatus in general what Mr. William J. Hammer has done for the incandescent lamp, as all will agree who have seen the remarkable lamp collection so industriously and faithfully got together by Mr. Hammer.

Philadelphia, Pa. Charles Wirt.

Regenerative Electric Traction.

To the Editor of Electrical World:

Sir:—I have read with much interest the editorial in your issue of Dec. 15 on "Regenerative Control on Direct-Current Railways," since I have been closely connected for more than seven years with the development and experimental work in that line carried out by the Johnson-Lundell Electric Traction Company, of London, England.

As to the "adjustable-speed motor" being, as stated, more promising than the "shunt-wound" motor for regeneration purposes, so far as I can see, the variable-speed series motor, or, to be more explicit, the series motor capable of speed variation by means of field control, is not any more practical for regeneration than the ordinary series motor controlled by armature resistances.

A shunt characteristic is essential to regeneration, whether this shunt characteristic is obtained by the use of a shunt field proper or by the use of more or less independent excitation. a means for counteracting the armature field and providing a suitable commutating field is no doubt a great help, though from my experience I hardly believe it to be essential, because by providing a suitable series field which is opposed to the independent (of armature current) field during the period of regeneration the maximum rush of current can be adjusted to whatever is desired from a retardation point of view—i. e., to obtain a cushioning effect and avoid jerks—and these requirements will be found to be as such as to limit the current sufficiently to enable ordinary commutating means to take care of it.

The modern tendency to raise the line voltage from 500 volts to 1000 volts or 1500 volts will, of course, necessitate the use of special commutating means for regeneration, but at those voltages these means are needed equally much during propulsion.

It seems a pity that regeneration in connection with direct-current traction does not receive more attention. I do not believe that the possibilities as regards saving to be effected by regeneration and the monetary value of such saving are at all appreciated. If they were, there would be such a strong demand for regenerative traction that it would be but a short time before it would reach the highest practical standard of perfection.

Davenport, Ia. J. Gustaf V. Lang.

[According to the Standardization Rules of the American Institute of Electrical Engineers, adjustable-speed motors are those "in which the speed can be varied gradually over a considerable range, but when once adjusted remains practically unaffected by the load; such as shunt motors designed for a considerable range of field variation." Variable-speed motors are defined as those "in which the speed varies with the load, decreasing when the load increases; such as series motors." The ordinary direct-current shunt-wound motor is designated as a "constant-speed motor."—Ed.]

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Three-Phase Series Motor.—R. Rudenberg.—The conclusion of his article on some properties of the three-phase series motor. The torque is proportional to the square of the voltage and depends also in a somewhat complicated manner on the speed and the angle of brush displacement. Fig. 1 gives the speed as a function of the brush-displacement angle for different constant values of the torque D. The normal torque is D_0 and the different curves relate to torques between $D = 2\,D_0$ and $D = 0.1\,D_0$. The ordinates give the ratio of the speed n to the normal speed n_0, the abscissas the angle of brush displacement. The curves are peculiar. For small brush displacement or for high speed the curves are similar to those of direct-current series motors. The speed decreases gradually with increasing torque and can be regulated very easily by brush displacement. An increase of the brush displacement from the short-circuiting position causes a decrease of the speed. But these statements are correct only to a certain ex-

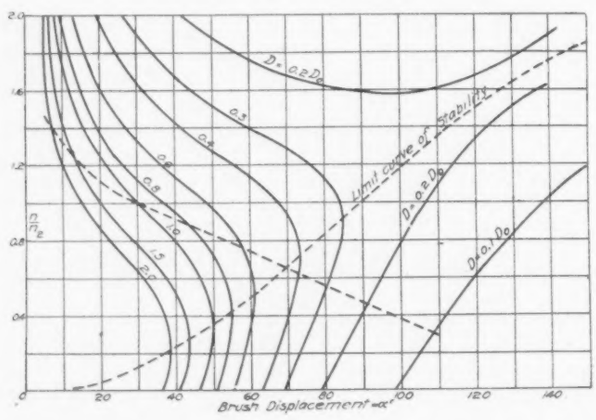


Fig. 1—Variation of Speed with Brush Position at Constant Torque.

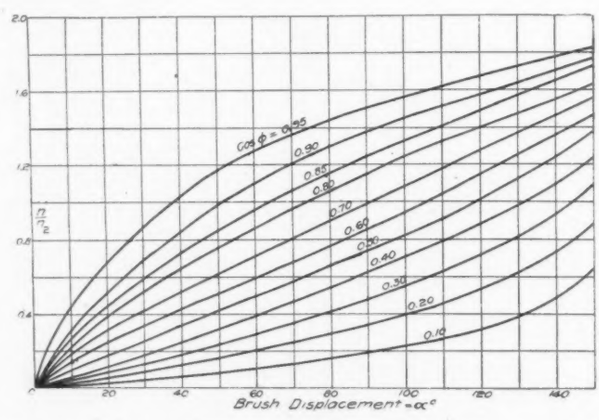


Fig. 2—Relation Between Power Factor, Speed and Brush Position.

tent, because the speed curves have a bending point at a lower speed, and especially for higher brush displacements, so that the speed then increases with increasing torque. This represents, of course, an unstable condition; the motor either runs up to a higher stable speed or it stops. The limit curve of stability is given by a dotted line in Fig. 1. Therefore, although it is possible to give to these three-phase series motors a strong starting torque by a suitable brush displacement, yet they cannot be maintained at low speeds; they continue to accelerate until they have passed the stability limit. The region of unstable lower speeds is a great disadvantage for various operations, but it can be completely avoided if the effective number of turns of the stator is made greater by a certain percentage than that of the rotor. Experiment shows that this simple remedy is very effective. The power-factor depends solely on speed and brush displacement. It is zero at rest, equals the cosine of half the brush-displacement angle at synchronism and becomes unity at double synchronism. It is given by the curves of Fig. 2. In order to get a power factor equal to unity for a speed below double synchronism it is necessary to make the effective number of turns of the rotor greater than that of the stator. This condition is just opposite to that given above for improving the stability region. Finally, results of actual tests of a motor are given.—*Elek. Zeit.*, Dec. 1.

Three-Phase Induction Motors.—TH. LEHMANN.—If the rotor of a three-phase motor is artificially brought up to synchronism it is well known that the wattmeter in the primary circuit shows a sudden reduction of the watt consumption when passing through synchronism. This fact has been explained in the past by the rotor hysteresis, the torque of which changes its sign in passing through synchronism. Benischke has recently claimed that the rotor hysteresis does not play any part in this because its torque was claimed to decrease with slip and to become zero at synchronism, and that the sudden drop of power is due to the total iron losses which are transformed at synchronism suddenly from the stator to the rotor and the driving engine. The present author endeavors to show that this theory of Benischke is wrong, and gives the theory of the rotor hysteresis at considerable length. The linear as well as the rotating hysteresis produces a torque independent of the slip. This torque changes its sign at synchronism; its numerical value depends solely on the hysteresis loss per cycle.—*Elek. Zeit.*, Dec. 8.

Ventilation of Inclosed Electric Machines.—P. AMSLER.—In order to cool inclosed electric machines effectively, ventilation channels are provided through which the cooling air is driven through the machine. The air, having passed through the machine, passes into a receptacle in the base of the machine in which it is cooled by means of copper tubes through which cold water flows. The cooled air is then driven again through the channels in the machine. By this simple means inclosed machines can be made to give the same capacity for the same temperature rise as open machines.—*La Revue Elec.*, Nov. 15.

The Irregularities in the Rotating Field of the Polyphase Induction Motor.—C. F. SMITH.—The full paper with illustrations, a shorter account of which was recently noticed in the Digest. The paper describes experiments to determine the amount of the irregularity. The investigations are based on the e.m.fs. induced in search coils on the stators of the motors tested.—Lond. *Electrician*, Dec. 9.

Generation, Transmission and Distribution.

Electric Energy for Agricultural Districts.—K. KROHNE.—The author reproduces an article from a daily German paper with a large circulation among farmers, in which it was claimed that central stations for energy distribution in agricultural districts are pushed by the manufacturing companies simply in order to sell their machines and not in order to help the farmer. It is doubted whether electric energy could be of so much use in agriculture. The present author criticises these remarks and shows in what respects electricity could help the farmer, although too much has been expected from it sometimes. Electric plowing will become more general when satisfactory energy supply will be available from large and efficient transmission plants. In the past at least twenty-eight electric plows have been put into operation. Of these, twelve are operated from an isolated plant, but six of these have already discontinued operation. In four cases a change is to be made to energy supply from a transmission system. Twelve electric plows are operated from transmission systems, but five have not yet been started on account of lack of available energy.—*Elek. Zeit.*, Dec. 8.

Water-Power in Sicily.—A note stating that although Sicily does not possess glaciers and is not rich in forests, there is sufficient water available for hydroelectric generation. In the Province of Syracuse the porous miocene limestone retains the water like a sponge, and powerful sources spring from the porous limestone belonging to the lias and jura of the interior. The eternal snow of Etna also gives plenty of water, and it has been calculated that 50,000 hp of waterfalls are available in Sicily. So far the Societa Elettrica della Sicilia Orientale has two plants—one in the northeast on the Alcantaro, and one in the southeast on the Cassibile. The main aerial distribution lines go along the east cost from Messina to Catania, Syracuse and Modica and have, with branches, a length of 130 miles. Further extensions are contemplated by this company, which has secured most of the water-rights. In the sulphur mines some 20,000 hp could be used. Here steam power is used exclusively at present, though coal is very expensive. The plant on the Cassibile River, on which a fall of nearly 300 ft. is utilized, renders available about 3000 hp. The construction of a reservoir has enabled twice the amount of power to be produced. On the Alcantaro 11,000 hp are gained; energy is generated at 50 cycles per second, 5250 volts, three-phase, and the tension is raised to 40,000 volts for the transmission.—Lond. *Eng'ing*, Dec. 2.

Electric Motors in Tin Mines.—An article on the electrically driven tin mines at Pusing Bharu and Siputeh, in the Malay peninsula. The power house contains three three-phase, fifty-period, 150-kw, 2200-volt generators. The e.m.f. of transmission is 2200 volts. The e.m.f. is reduced to 440 volts for driving various induction motors.—Lond. *Electrician*, Dec. 9.

Generating Station.—SIMONSEN.—The first part of an illustrated paper on the new steam-turbine generating station at Reisholz of the Rhenish-Westphalian electricity works. For the sake of the condensing water the plant has been placed directly on the River Rhine. In the present instalment details are given on the boilers, economizers and the treatment of the feed water.—*Elek. Zeit.*, Dec. 8.

Smoke Prevention.—A. J. SWITZER.—An article on the effectiveness of smoke prevention by means of steam-jet devices for boiler furnaces. The author gives data on the operating cost of these steam-jet devices and finds that they not only prevent smoke, but that the prevention of smoke is of considerable economy.—*Eng. Mag.*, December.

Traction.

Paris North-South Electric Railway.—A note on the recent opening of this railway. A 750-volt, three-wire system of distribution is employed. An overhead conductor is the positive outer, while a third-rail, outside the running rails, is used as the negative and the running rails as the neutral. In this way it is hoped that stray currents will be avoided. To insure perfect balance each train is worked by two motors, one of which is connected between the overhead conductor and the track and the other between the third-rail and the track. These motors are operated simultaneously by a multiple-control system, so that there is equal consumption everywhere. Two 100-kw motors are used with each train. The supply pressure is 2×750 volts. At the substations three-phase current at 10,000 volts or 15,000 volts is brought in from St. Denis or Ivry and is converted to continuous current at the working voltage. Signaling is effected by using a "permissive" signal at the entrance to each station, even if the preceding train has not cleared the block section in front. In case of accident the stoppage of trains in the tunnels is thereby prevented.—Lond. *Electrician*, Dec. 9.

Electric Railways.—C. Heilfron.—The first part of a profusely illustrated French translation of his recent German article on various details of electric equipment on trunk railways, giving an outline of the different systems and especially of the different motors and their regulation.—*La Revue Elec.*, Nov. 15.

Lamps and Lighting.

Metallic-Filament Lamps.—R. W. Hutchinson, Jr.—An article giving briefly the chief data on service characteristics and relative economy of metallic-filament lamps with reference to different methods of manufacture.—*Eng. Mag.*, December.

Installations, Systems and Appliances.

Austrian Central Stations.—An account of the proceedings of the seventh annual meeting held last summer in Graz by the Association of Austrian and Hungarian Central Stations. The president, Karel, reported on the bureau for buying incandescent lamps which operates in conjunction with the lamp-testing bureau of the Vienna Municipal Central Stations. The value of the lamps bought by the bureau last year was $83,806, of which 63 per cent was for carbon lamps and the balance for metallic-filament lamps. The testing bureau tests about 300,000 incandescent lamps per year. Legislation in Austria and Hungary was the subject of several papers. Heicke reported on the commercial results of the introduction of metallic-filament lamps on the basis of experience of fifty-one central stations. The number of metallic-filament lamps in per cents of all incandescent lamps used by these stations varies between 3 per cent and 100 per cent, and averages about 36 per cent. While formerly the 16-cp carbon lamp was the standard, the average of the lamp size has now been raised to 36 cp for metallic-filament lamps. Only seven out of fifty-one stations experienced a reduction of energy consumption due to the introduction of the metallic-filament lamp; in three of these stations this loss has not yet been overcome. Ten other works have experienced a smaller increase than usual of energy consumption and attribute this to metallic-filament lamps. Out of forty-one stations twenty-eight were able to increase the number of their consumers, due to metallic-filament lamps, while thirteen stations did not get such an increase. Out of twenty-four stations, eighteen state that metallic-filament lamps have greatly facilitated competition with gas lighting. New regulations have been proposed for first-help in electric accidents. Hartmann reported on amortization in electricity works.—*Elek. Zeit.*, Dec. 8.

Argentina.—G. Berndt.—An article giving statistical data on the central stations of Argentina. Details are given of the history, equipment, rates, etc., of thirty-seven stations. The total aggregate rating is 99,000 kw. Seventy-four per cent of this equipment is installed in Buenos Ayres. Fifty-four per cent of the total equipment in the country is driven by steam turbines, 40 per cent by steam engines, 5 per cent by water turbines, and 0.5 per cent by suction-gas engines. Twenty-six prime movers of 38,900 kw are of Italian make, twenty-five of 27,143 kw of German make, sixty-eight of 26,204 kw of American and English make, and the balance (a total of 9000 kw) of Austrian, Belgian, French and Swiss make.—*Elek. Zeit.*, Dec. 8.

Wires, Wiring and Conduits.

Submarine Cables.—C. Bright.—The first part of an illustrated paper on submarine-cable laying and repairing.—Lond. *Electrician*, Dec. 9.

Electrophysics and Magnetism.

Magnetic Properties of Iron and Its Alloy in Intense Fields.—R. A. Hadfield and B. Hopkinson.—A paper read before the (British) Institution of Electrical Engineers. The magnetic properties of materials in fields of very high density are of great scientific interest, because the relation between B and H then assumes a very simple form. This relation is $B = H + 4\pi I$, where I is the sum of the magnetic moments of the molecular magnets per unit volume. If the moment of a molecular magnet can be assumed unaffected by the applied forces, I is constant when H varies, though it might vary with other physical conditions which affect a separate molecule. In this connection the experiments of Ewing and Low show that in iron, cobalt, nickel and some alloys the mutual attractions between the molecules are almost completely overpowered by a force of 2000 c.g.s. units, while the magnetic moments remain unaltered unless the force exceeds 25,000. The quantity I is called the magnetism of the material. The authors describe in detail experiments that they have made to test the behavior of different kinds of irons and iron alloys in fields more intense than 7000 c.g.s. units. The chief results are as follows: Every alloy examined, without exception, has a definite saturation intensity of magnetization. In most cases this is reached in a field of 5000 units, but in a few there is a small increase, as between 5000 and 25,000. The forms of the curves of magnetization connecting I and H in these exceptional materials, however, leave no doubt of the existence in them also of a saturation value of I. Every one of the materials tested, without exception, behaves as though it consisted of a mixture of magnetic substances with non-magnetic substances having a permeability not differing materially from unity. This holds good also for the non-magnetic or nearly non-magnetic nickel or manganese alloys, and in this respect the results differ from those obtained by Ewing and Low, according to whose experiments a nearly non-magnetic manganese steel had a constant permeability of about 1.4. Among all the alloys which have been tested there is none having a constant permeability differing from unity by more than 2 per cent. There is in the series no alloy having a higher specific magnetism than pure iron. The saturation value of I for pure iron of density 7.80 in absolute units is 1675, within 1 per cent. This is slightly lower than the values obtained by Ewing and Low and other experimenters. In an annealed iron-carbon steel in which other elements are present in small proportions the specific magnetism is less than that of pure iron by a percentage equal to six times the percentage of carbon. This result constitutes a verification, in the case of annealed iron-carbon alloys, of the linear relation connecting the magnetism of a mixture with the magnetism of its constituents. In this case there are two constituents mechanically mixed—namely, the pure iron and iron-carbide—the percentage of iron-carbide being 15.5 times that of the carbon in the steel. It is readily deducted from this equation that the magnetism of carbide of iron is about two-thirds of that of pure iron. Quenching an iron-carbon alloy from a high temperature reduces the specific magnetism by a large but somewhat uncertain amount. The addition of silicon or aluminum to iron results in a reduction in specific magnetism which is roughly in proportion to the amount added as though the addition behaved as an inert diluent. If carbon be present, however, silicon seems to neutralize its action to some extent. For instance, an alloy containing 2.28 per cent Si and 0.67 per cent C is 3.6 per cent less magnetic than pure iron, whereas if the carbon had its full effect, as in iron-carbon alloys, and the silicon were simply an inert diluent, the reduction would be 6.3 per cent. The observations on the alloys of iron with nickel and with manganese, or with both these elements, have failed to reveal any simple relation between their magnetism and their composition. It is probable that this is due to the peculiar effects of heat treatment on these substances.—Lond. *Electrician*, Dec. 9.

Conversion of Cathode Rays Into Roentgen Rays.—J. H. Gardiner.—A paper on quantitative measurements of the conversion of cathode rays into Roentgen rays by anticathodes of different metals. Various scientists have suggested that the metals of high atomic weight are best suited as anticathodes for converting the cathode rays which impinge upon them into Roentgen rays. A high melting point is also essential, as the cathodes become strongly heated, and anticathodes of osmium, iridium, tantalum, uranium, as well as anticathodes coated with these metals, have hence been tried. Quantitative measure-

ments of the efficiencies of different metals as anticathodes can be conducted in two ways, either by measuring the conductivity of a definite stratum of air exposed to the radiation (ionization method) or by measuring the density of the deposits of silver obtained after development of the latent image produced in a photographic film by the rays. The present author chose the photographic method, not unprepared for the difficulties he had to overcome. By preliminary experiments he first fixed the direction of maximum intensity of Roentgen-ray emission. According to G. W. C. Kaye (ionization experiment) this direction is at an angle of 30 deg. to the normal to the anticathode; according to the present author it is 30 deg. from the plane of the anticathode. The two observers (or methods) thus differ by 30 deg. The darkness of the silver deposits produced when the rays fell upon the plate through a slit in a lead shield, curved like a bulb, varied sufficiently to allow of measurements. But it was doubtful whether inequality in the thickness of different portions of the glass bulb and the gradual hardening of the bulb while being worked would not vitiate the effects. The author satisfied himself that the bulbs were sufficiently uniform and that the hardening effect, though real, would not disturb his results. He used Ilford X-ray plates, and Mees prepared for him special low-process emulsion plates of perfectly uniform film thickness. The experiments were made by comparing the efficiencies of a half disk of platinum, the standard metal, and of a half disk of the respective metal. The two half disks were mounted on an anticathode of nickel and clamped down upon the nickel and the cathode rays were deflected either to the right or to the left to obtain reflection from the one or the other metal; thus pairs of observations were taken in series. Use was made of direct current at 220 volts interrupted by a mercury jet-interrupter 125 times for each opening of the photographic window, and a plate surface of about 1 sq. cm was exposed for seven seconds after the tube had been working for three seconds. The results were peculiar. The order of the X-ray efficiency of the materials tested was: Iron, 40.4 per cent; nickel, 42.4; carbon, 60.4; aluminum, 65.7; silver, 66.4; gold, 86.1; tantalum, 90.5; uranium, 92; platinum, 100. The order of the atomic weights was: Carbon, 12; aluminum, 27; iron, 56; nickel, 59; silver, 108; tantalum, 181; platinum, 195; gold, 197; uranium, 238.5. Thus carbon and aluminum proved much more effective than would be expected from their low atomic weights, and gold and uranium much less. An alloy of nickel and platinum proved as efficient as platinum, and it resulted that the surface of this alloy to a thickness of 0.001 mm consisted of platinum; this anticathode was, therefore, practically a platinum anticathode—that is, until it cracked and began to fuse. The bulbs themselves did not get hot during the experiment.—Lond. *Eng'ing*, Dec. 2.

Gamma Rays.—D. C. H. FLORANCE.—A paper giving, first, the results of an experimental investigation of the initial absorption of gamma rays by lead under ordinary experimental conditions. In the second part the author takes up the discussion of the secondary gamma radiation, dealing with its distribution and quality and discussing the question whether the secondary gamma rays are true secondary rays or scattered primary rays. His conclusions favor the opinion that the secondary gamma rays are scattered primary rays.—*Phil. Mag.*, December.

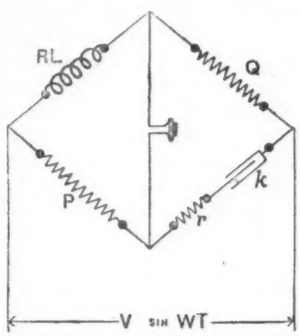
Hysteresis Loss.—R. RICHTER.—The author proposes to use for the hysteresis loss not the formula of Steinmetz, $V = B^{1.6}$, but a formula containing two terms, $V = aB + bB^2$. The total magnetization heat, including hysteresis loss and eddy-current loss, is then given by the formula $V = aB + (b + d)B^2$. This formula is more convenient for use in connection with the slide rule than the usual formula $V = CB^{1.6} + dB^2$. The author gives seven examples which show that the formula $B = aB + dB^2$ for the hysteresis loss gives results which are in more exact agreement with the measured values than the values calculated by Steinmetz's formula. The differences are less than one-half those found in Steinmetz's formula.—*Elek. Zeit.*, Dec. 8.

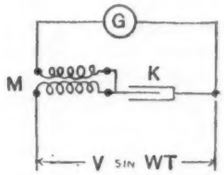
Electrochemistry and Batteries.

Ozone for Water Sterilization.—An illustrated article on the Otto system for sterilization of water by means of ozone. Figures are given on the cost of the Bon Voyage plant in Nizza. The energy consumption is 1.26 kw-hours per 100 cu. m, hence, the cost of the kw-hour being 0.6 cent, the cost of electric energy consumption is 0.0076 cent per cubic meter. The cost of maintenance and attendance is 0.036 cent and the cost of pumping 0.033 cent per cubic meter. Hence the total cost is 0.076 cent per cubic foot of water sterilized.—*La Revue Elec.*, Nov. 15.

Units, Measurements and Instruments.

Measurement of Self-Inductance and Effective Resistance at High Frequency.—C. E. HAY.—To measure the effective resistance of inductive circuits at telephonic frequencies is difficult in cases where the inductance is large compared with the resistance, as in loading coils for telephone circuits. On this account all the null methods known to the writer, which have been devised to measure self-inductance alone, are unsuitable, and especially so at frequencies of the order of 2000 per second. The author's new apparatus for this purpose is joined up like a Wheatstone bridge(Fig. 3), a telephone being used





Figs. 3 and 4—Diagrams Showing Connections of Instruments.

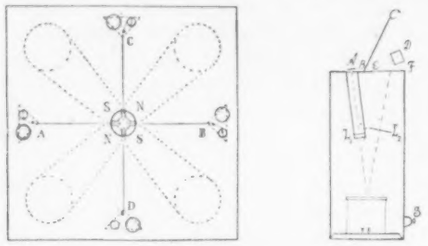
in place of a galvanometer. R is the effective resistance to be measured; L the self-inductance to be measured; PQ, non-inductive anti-capacity resistance (variable); r the balancing resistance (variable); k the balancing capacity (variable); w is 2π times the frequency of alternations. The resistance r must be capable of very fine variations, and also the capacity k; for the latter mica and air condensers are necessary. The insulation of the different apparatus and the wiring would be very high and in order that the capacity to earth of the leads to the source of the e.m.f. and the generator should not affect the test it is best to take the current to the network from the secondary of a transformer which has its windings highly insulated from each other. Means should also be adopted to avoid capacity between the primary and secondary windings. L and R are then given of the following formulas:

$$L = PQ\,\frac{k}{k^2r^2w^2 + 1}$$

$$R = PQ\,\frac{k^2rw^2}{k^2r^2w^2 + 1}$$

The frequency must, therefore, be known. At the moment of making a test the actual frequency can be determined electrically as follows: A variable mutual inductance and a highly insulated condenser of 1 microfarad are joined up to a sensitive thermo-galvanometer, as in Fig. 4. For the frequencies met with in telephonic work a condenser of 1 microfarad and a small range of low mutual inductance only are necessary. For no current through the galvanometer $w^2MK = 1$. The method is particularly valuable for measuring the effective resistance and self-inductance of loading coils used for telephonic purposes. Its usefulness is, however, not confined to this, as it appears to have great sensitivity over a very large range. The ratio R/L, which is required in connection with the loading of telephone cables, is very easily obtained by the method, being simply equal to krw^2.—Lond. *Elec. Review*, Dec. 9.

Phaseography.—M. Siegbahn.—An illustrated mathematical paper on the study of variable currents by means of the phaseograph. It is an oscillograph with two movable systems, one registering strength of current, the other voltage, and the chief feature is that the two movable systems are made to cooperate. The apparatus consists of two parts: the electromagnet and a box of brass with an ebonite or slate lid. The electromagnet is made of a soft-iron ring with four upright iron rods. Each of these is covered with a solenoid of copper wire. The solenoids have been arranged so as to close to



Figs. 5 and 6—Phaseograph.

80 volts if coupled in series. In the brass box are fixed four pole-pieces of the shape indicated by Fig. 5. Each of these is provided with a cylindrical plate which fits one of the four electromagnets. In the magnetic field *NS, N'S'* are extended two thin silver wires (diameter 0.02 mm) *AB* and *CD*. The tension in these wires can be regulated by means of special screws. The larger screws are used for turning on the electric current. At the crossing point the two wires are insulated with a plate of mica and are also provided with a smaller mirror. If a constant current is made to pass through one wire, for example, *AB*, one-half will be lifted owing to the magnetic field, and the other will be pressed down, hence the mirror will be turned at a certain small angle. With sufficiently small angles the turning is proportional to the strength of the current. Owing to the great tension in the wire the new equilibrium is not restored until after a considerable time of oscillation. If the box is filled with a suitable damping fluid this movement can be made aperiodic. Castor oil is used. The mounting and the special arrangements are shown in Fig. 6. The Nernst-style *A* throws a sharp light on a small diaphragm, which at exposure can be shut out with a shutter. By the aid of the two lenses, L_1 and L_2, an image is formed on the ground-glass plate *EF*. For photographic purposes the latter is replaced by a chassis with plate. The lens and the diaphragm are sheltered from outside light by a cardboard tube. In order to study a current curve—that is, use the phaseograph as an ordinary single oscillograph—a revolving mirror with driver is put on, and the ground-glass plate is removed. The image then appears on the screen *BC;* the desired current curve is obtained by putting the mirror in rotation. By means of binding-screws and interrupters ($S_{1\ 2\ 3}$) on the outside of the box the electric current is conducted to the electromagnet (S_1) and the two measuring wires (S_2 S_3). The author deals briefly with other double oscillographs and describes more in detail the working of his apparatus and its application to the registration of the relations between current and voltage in alternating-current circuits with self-inductions, capacities, transformers, etc.—*Phil. Mag.,* December.

Temperature Compensation of Millivoltmeters.—Kollert.—The author deals with the temperature compensation of Swinburn for millivoltmeters which with a shunt are to be used as ammeters with zero temperature-resistance coefficient. The arrangement is shown in Fig. 7, where the copper winding w_2 of the instrument is in series with a manganin resistor w_1, so that both together have a temperature coefficient smaller than that of copper. These two resistors are connected in parallel with a copper resistor w_3 and the whole combination is in series with the manganin resistor w_4. Let *E* be the potential difference between the terminals *A* and *B* of the instrument for a current *i* in the coil w_2 and for a certain initial temperature. It is then always possible to select the resistance of w_4 so that the potential difference *E* between *A* and *B* remains the same for another temperature, the current *i* being the same. The author deals mathematically with the problem of selecting the resistance of the resistor w_3 and the joint temperature coefficient of $w_1 + w_2$ so that *E* becomes as small as possible, and of finding the minimum value of *E*. A numerical example is added.—*Elek. Zeit.,* Dec. 1.

Non-Inductive, Low-Resistance Standard.—C. V. Drysdale.—An illustrated article on a new form of non-inductive, low-resistance standard or shunt. The resistor described is made by cutting the electrodes into a number of thin strips or fingers which intercalate with one another, thus reducing the inductance to a very small figure. Several different forms of

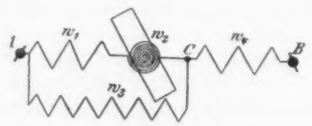


Fig. 7—Plan for Temperature Compensation of Millivoltmeters.

construction are described and illustrated.—Lond. *Electrician,* Dec. 9.

Analysis of Alternating-Current Curves.—A. Schleiermacher.—A mathematical paper on the method of resolving a periodic function in the form of a Fourier series by arithmetical analysis. The object is to reduce as much as possible the number of tiresome multiplications.—*Elek. Zeit.,* Dec. 8.

Telegraphy, Telephony and Signals.

Cable Receiver.—A. C. Crehore and G. A. Squier.—A paper describing a cable recorder in which variations of current are recorded by means of interference bands or fringes. The coil in the recorder carries two small, thin plates of optical glass for producing interference bands. When the current is passed through the coil a torque is produced and transmitted through silk fibers to the upper glass plate, thus changing the pressure between the plates and altering the thickness of the thin film of air confined between them, and thus moving the system of interference bands. A commercial mercury-vapor lamp may be used. A current of 20×10^{-6} amp is a good working value for this recorder. The corresponding value for the syphon recorder is 42.5×10^{-6} amp.—Lond. *Electrician,* Dec. 9.

Frequency of Telephone Currents.—K. W. Wagner.—An account of an experimental investigation carried out in the German Telephone Department. The chief result is that in the transmission of speech by the telephone only the frequencies between $2\pi f = 3000$ and 6000 are essential. To determine the efficiency of telephone transmission it is chiefly necessary to consider the frequency $2\pi f = 5000$ per second. The damping coefficient should be made as small as possible for this frequency, while the uniformity of the damping coefficient for a wide range of frequency is of much smaller importance.—*Phys. Zeit.,* Dec. 1.

Fire-Alarm System.—An illustrated description of a new fire-alarm system devised by L. T. Reichel. It is unaffected by dust and vibration, as no line contacts are involved, nor are there batteries. The Reichel system depends upon the use of thermopiles made up of couples of bismuth and an antimony alloy. Such couples are mounted in a porcelain block *C* in such a way that only one series of junctions *AB* is exposed to the air (Fig. 8). The blocks, with their couples protected from accidental mechanical injury by a suitable grid, are mounted on the ceilings of the apartments which it is desired to protect. The room may be gradually heated to any degree of temperature that comfort or utility demands without affecting the alarm device, due to the fact that the length of each couple is so short that the temperature lag of the unexposed junction follows closely behind the exposed junction, so that at an ordinary rate of temperature increase little or no thermo-e.m.f. is generated, whereas if a sudden rise of temperature occurs in a room where the pile is installed, such

as would arise from even a small conflagration, a thermo-e.m.f. will instantly be generated sufficient to operate the alarm. The indicator, Fig. 9, consists of a sensitive moving-coil relay, the tongue of which carries a light iron disk 1 upon which the platinum contact point is mounted. In juxtaposition thereto is an adjustable iron screw *AS* which carries the fixed contact and which is magnetized. These contacts form part of a local circuit, including a suitable battery and such warning bells *B*

Fig. 8—Thermopile.

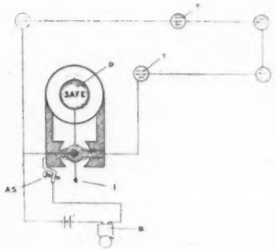


Fig. 9—Indicator.

as are necessary. A deflection of the coil from its normal position moves the iron disk into the range of magnetic pull of the screw when the former is pulled over and the contacts held firmly together until the coil is restored by hand. The adjustable screw forms a ready means of fine adjustment of the range of operation of the warning, already approximately determined by the selection of the number of couples in the detectors *T*. The moving coil also carries an arm to which is attached a disk *D*, which, according to its position, displays the words "safe" or "fire" through a window in the indicator case.—Lond. *Elec. Review*, Dec. 9.

Wireless Time Signals.—G. W. O. HOWE.—An illustrated description of the arrangements made at the Central Technical College, in London, whereby the Norddeich wireless-telegraph time signals can be checked against Greenwich time with an error not exceeding 0.1 second.—Lond. *Electrician*, Dec. 9.

BOOK REVIEWS.

ANALYSE DES METAUX PAR ELECTROLYSE. By A. Hollard and L. Bertiaux. Paris: H. Dunod and E. Pinat. 256 pages, 18 illus. Price, 9.50 francs.

This is a thoroughly practical treatise on electrolytic analysis of metals, describing processes, details and precautions. The first part deals with the principles of analysis by electrolysis and a classification of metals from this standpoint. The second part discusses the treatment of the electrolytes to be analyzed. The third part takes up the metals in succession, and the fourth gives a number of actual experimental results obtained. The book will be of interest and value to students of electrochemistry and of chemical analysis. It is very clearly written and each process is reduced to its lowest terms in expression.

THE STORY OF THE ATLANTIC CABLE. By Charles Bright. New York: D. Appleton & Company. 222 pages, 54 illus. Price, $1 net.

Mr. Bright has already written on the submarine cable in more voluminous form, but his larger volumes are not generally accessible to the American public. He now tells the story again very succinctly and well, and his book is a useful and desirable companion to that by Dr. Field, who may perhaps be said to have taken the American point of view. Aside from the historical portion, which is, of course, by no means new, though ever interesting as a narrative of a great achievement, there is much other matter of value, in handy condition. Mr. Bright gives details as to existing lines, tariffs, capitalization, etc. He states that the fifteen Atlantic cables now in existence represent $100,000,000, with a gross annual yield of $6,000,000. The reproduction of some of the old plates and portraits was a good idea. Mr. Bright's treatment of the subject is popular, and is intended for the general reader rather than in any sense for the technical student.

WORK-ACCIDENTS AND THE LAW. By Crystal Eastman. New York: Charities Publication Committee. 361 pages, illus. Price, $1.50.

The present volume is one of six presenting the findings of the Pittsburgh Survey and is one of the Russell Sage Foundation publications. The field work upon which the discussions are based was done between July 1, 1906, and June 30, 1907, a period of great industrial activity during which 526 men were killed in work-accidents in Allegheny County. The work is divided into three parts, namely: Causes of Work-Accidents, Economic Cost of Work-Accidents, and Employer's Liability. The last 100 pages are given over to 12 appendixes consisting of articles by various specialists, reports of various bodies and classified data. Miss Eastman immediately dispels certain common illusions by demonstrating that by industrial accidents Allegheny County loses more than 500 workmen every year, of whom nearly 50 per cent are American born, about 70 per cent are skilled workmen and 60 per cent have not yet reached the prime of their life.

In the part on causes the industries are classified under the following heads: Railroads, coal mines, steel mills and miscellaneous, and a chapter devoted to each. The economic cost is studied by analyzing the accident cases occurring in the district and showing the consequences of the accidents and the compensation received.

The facts and data are presented in a very intelligible manner, frequent use being made of diagrams to bring out forcibly the meaning of certain groups of comparative figures. The book represents the results of a great and good work and the information here presented should be of great value in the guidance of those engaged in bettering the existing conditions surrounding American labor.

New Apparatus and Appliances

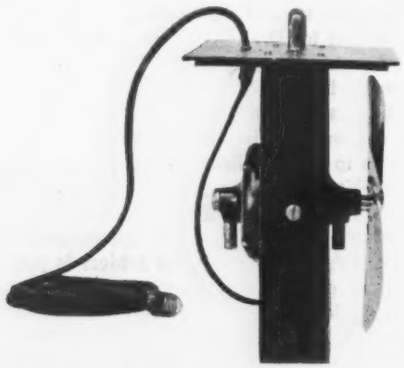
APPLICATION OF FAN MOTORS FOR WINTER USE.

It has been the popular opinion that the range of usefulness of the electric fan motor is limited to the summer months and that its sole utility lies in its application as a means of reducing the temperature of a room or an office. The public, however, is slowly but surely beginning to understand that the usefulness of the fan motor is by no means confined to the hot days of summer. Following are a few of the more important applications of the fan motor to winter use which have from time to time been pointed out in these columns:

The efficiency of the hot-air heating system may be greatly increased by placing a fan motor in the cold-air box to force the air through the registers to all parts of the house. On particularly cold days, when the wind is so strong that it forces the air through the furnace into the rooms without having become heated, a fan motor placed in the cold-air box, after having closed the slide which permits air to come in from the outside and opening the slide which lets the air in from the cellar, will cause an appreciable rise in the temperature of the room without making any increase in fuel consumption.

It is very often the case that the house contains a room or

rooms which under certain conditions are difficult to heat. This difficulty can be overcome by placing a fan motor in front of the hot-air register or over it in case the register is located in the floor. This plan will prove more efficient if the register and fan motor are covered by a box or hood of some kind which will cause the fan motor to draw air from the pipe only and not from the room.



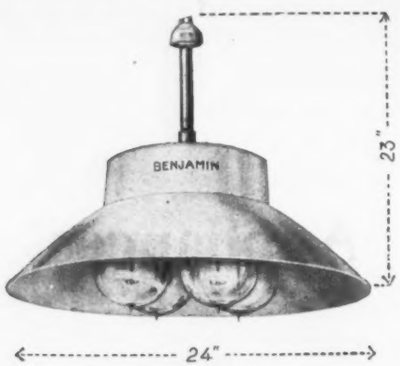
Electric Fan for Winter Use.

In a house heated by hot air or steam increased radiation of heat and consequently a warmer room may be obtained without any difficulty by placing a fan at the end or back of the radiator.

Another manner in which the fan motor may be used to advantage in winter is to prevent the accumulation of frost on show windows of stores. The air from the fan motor directed against the glass of the window will keep it practically free from frost. This application of the motor is a boon to merchants who have heretofore during the cold weather lost practically all the advantage which their window display accomplishes. The outfit shown herewith is built by the General Electric Company.

MILL CLUSTER.

The Benjamin Electric Manufacturing Company, of Chicago, has placed upon the market a cluster fixture which is intended to replace arc lamps in mills, factories, foundries, etc. The accompanying illustration shows one of these clusters with a 24-in. enameled-steel concentrating dome reflector for meeting requirements where it is necessary to hang the light units sufficiently high to clear traveling cranes. A second form has a 24-in. enameled-steel flat-cone distributing reflector, and is designed to be suspended from 25 ft. to 30 ft. above the floor. Both fixtures have sockets for 250-watt large-base lamps and are furnished wired in series for 220-volt circuits or series multiple for 110-volt circuits. The manufacturers state that a reflected light volume of approximately 1500 cp is secured by this means.



Cluster Fixture.

AN ELECTRICALLY OPERATED MUNICIPAL PUMPING STATION.

By Alexander J. Lindsay.

The question of water supply for any municipality is an extremely important problem. This is especially true if the city is rapidly increasing in population and provision must be made for future growth. One of the best examples illustrating this problem is furnished by the City of Spokane, Wash., which has just completed the fifth addition to its pumping stations within twenty-six years.

Up to 1898 various additions brought the capacity of the pumping system up to 17,000,000 gal. per day. As the city grew the hills south of the business section became rapidly occupied and, as the elevation of these was too great to be served by the same system which furnished water to the rest of the city, it became necessary to build two auxiliary pumping stations, one at Fifth Avenue and Pine Street and the other on Bishop Court near Monroe Street. These supplied 2,500,000 gal. a day from the low-pressure system to the hill section. These pumps were driven by electric motors. An attempt was made to install high-pressure pumps in the main station on the river bank, but it was found that the old low-pressure main was not capable of withstanding the high pressure necessary to reach the hill sections of the city. At the time this attempt was made a new 30-in. riveted steel low-pressure main and a 20,000,000-gal. reservoir were built for the low-pressure service and four 2,500,000-gal. pumps were installed in the river station. The addition of these pumping units carried the total capacity of this system up to 29,500,000 gal. per day and the low-pressure system of the city was in splendid shape so far as quantity was concerned.

Fig. 1—Exterior of Spokane Pumping Station. New Electrically Operated Station on the Right.

During all this time the valley of the Spokane River was being rapidly settled and the small town of Cœur d'Alene, situated where Lake Cœur d'Alene empties into the Spokane River, was rapidly becoming a city. This condition existing above the point where the water supply for Spokane was secured naturally tended to jeopardize its purity, and city officials eventually found it necessary to condemn the source of water supply. At first it seemed probable that a new and entirely different source would have to be sought and the existing pumping stations abandoned.

During the construction of the up-river pumping station it became necessary to dig pits for placing foundations, and it was found that the water rose in these pits to a considerable height, suggesting that there was a source of water supply either entirely separate from the river or else being supplied by infiltration. When it became necessary to seek a new supply a very thorough investigation of the quantity and character of the underground water supply was made. Test wells were sunk at various points from Cœur d'Alene Lake down the river to the water works. Analyses of the water obtained from these wells showed it to be different from the water of the Spokane River. It was clear and pure and the only objectionable feature was the hardness due to contained mineral matter. It

was thought that a sufficient supply could be obtained from this source, but to make certain before the expenditure became too great a large well 30 ft. in diameter was excavated back of the main pumping station. Two centrifugal pumps with a capacity equal to that of all the pumping machinery in the city were connected to this well and operated for a long time. While the level of the water in the well was lowered to some extent during pumping, it immediately rose when the pump was shut down, and it was evident that the well had more than sufficient capacity amply to supply the city. This well was connected to the pumps in the river station and this supply was substituted for that from the river.

In the spring of 1908, the demand for water having again reached the capacity of the installed pumps, the two remaining wheels in the old station were loaded with two additional pumps of 2,500,000 gal. capacity each, bringing the total capacity of the station to 2,450,000 gal. per twenty-four hours. While this helped out temporarily, it was apparent that additional facilities would have to be supplied and plans were, therefore, put under way to meet the requirements.

Fig. 2—Three Motor-Driven Centrifugal Pumping Units in the Spokane Pumping Station. Capacity per Twenty-four Hours, 12,000,000 Gallons Against 260 Ft.-head.

It was decided that it would be best to dig a new well tapping the underground supply and to build an electrically operated pumping station, as the power supply obtained from the river was in use to its limit. Plans were drawn, bids advertised for and finally a contract was let to the Allis-Chalmers Company for furnishing three motor-driven centrifugal pumping units. The installation of these has just been completed and is of particular interest as demonstrating the possibilities of this class of machinery for supplying water to large municipalities.

PUMPING STATION.

The new pumping station, which is entirely independent of the older station, is absolutely fireproof, being built with concrete foundations and steel and brick superstructure. It is supported on piling capped with a timber grillage, all of which is below low-water mark. The floor of the pumping station is itself 4 ft. below high-water mark. In order to insure water tightness the basement floor and the walls, to a height of 7 ft., were made waterproof by the use of asphalt felt and asphaltum. The interior walls were also made more impervious to the seepage of water by being plastered with a coat of neat cement, which also improves their appearance. The interior dimensions of the station are approximately 51 ft. 6 in. x 81 ft. 6 in.

The three pumping units now installed are placed along one side of the station with their shafts parallel to each other and at right angles to the side of the station, as shown in the accompanying drawing. They are spaced 15 ft. 6 in. on centers. Each unit consists of a 900-hp, three-phase, 60-cycle, 2300-volt, 880-r.p.m. induction motor direct-connected to two 14-in. two-stage centrifugal pumps.

Inasmuch as this equipment is representative of the most advanced procedure in this class of pumping equipment, a detailed description of both the pumps and motors may be interesting. Each centrifugal pump is of the Allis-Chalmers two-stage, single-end suction, horizontal-shaft type. It is supported by brackets cast integral with the casing, which rest upon and are bolted to a baseplate. The shaft is made of open-hearth steel and is amply large to carry the maximum loads without serious deflection. The impellers, which are of the inclosed type, are made entirely of bronze and are fastened to the shaft by means of a feather key and nut. A bronze sleeve is also used to protect that portion of the shaft exposed to the action of the water. A stationary guide passage is placed between the two impellers, its function being to take the water from the tips of the vanes of one impeller and deliver it through suitably shaped passages to the inlet side of the succeeding impeller. The last impeller discharges in a radial direction through guide vanes into the casing. A balancing disk, connected with both the suction and discharge sides of the pump, maintains a practically perfect running balance. The bearings are of the ring-oiled type lined with composition and the oil is supplied from a large oil reservoir. Stuffing boxes on both the discharge and suction sides of the pump are provided with bronze water-sealing rings to prevent ingress of air.

The motors are of Allis-Chalmers standard design. They receive three-phase, 60-cycle currents at 2300 volts and will deliver 900 hp when making 880 r.p.m. The laminations from which the stator core is built up are supported in a substantial

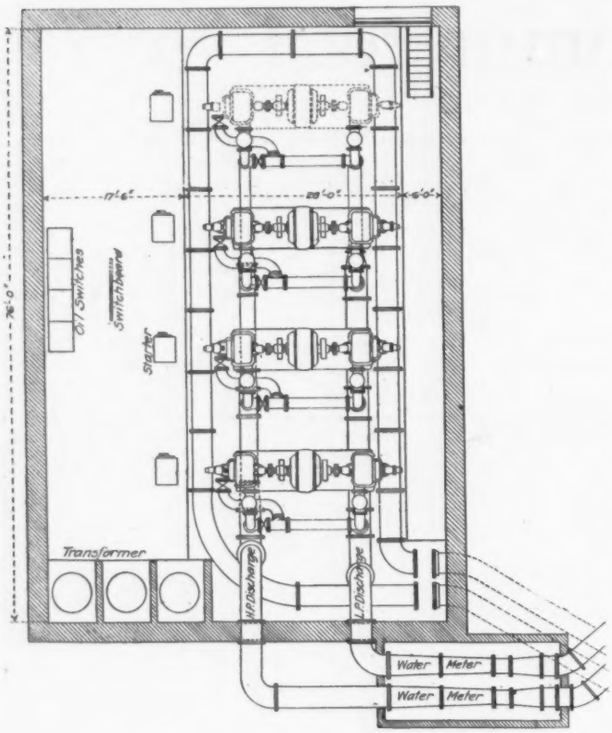


Fig. 3—Plan of Spokane Pumping Station.

cast-iron yoke which holds them securely in position. Cored openings are provided in this yoke and allow free circulation of air around the core and coils. Large ventilating ducts are provided. Special care is taken with insulation, and the copper is designed in such a way as to give a very cool-running motor.

The starting devices furnished with each motor include a bank of cast-iron resistance grids mounted in an expanded-metal case and arranged for connection with the collector rings. The resistance of the grids is such that a period of two minutes may be consumed in bringing a motor up to full speed with a temperature rise in the resistance not exceeding 175 deg. C. The starters cut out this resistance in steps to secure proper acceleration of the motor. The collector rings are short-circuited by a manually operated device when the motor is up to full speed.

Heavily insulated lead-covered cables placed in the concrete floor connect the motors to the switchboard. Similar cables carried in conduits in the wall of the building connect the transformers to the switchboard.

The switchboard is located at one side of the station with the high-tension oil switches in concrete cabinets back of it. The transformers are placed in one corner of the room. The switchboard is made up of four panels of blue Vermont marble mounted on an iron framework which leaves a space of 25 in. between the bottom of the board and the floor. On the switchboard are mounted an ammeter, a watt-hour meter, a voltmeter and various other necessary instruments. Three 1000-kw, oil-insulated, water-cooled, single-phase transformers change the 13,200-volt line voltage to 2300 volts for the station service. Taps are provided on both windings which give approximately 3 per cent, 6 per cent and 9 per cent lower voltages. Transformers are connected in delta with a grounded neutral so that if one should fail it can be disconnected by means of switches and the station operated at one-half capacity on the two remaining transformers.

The contract required that the machinery be placed in the station by June 1, 1910. Some delay was experienced by the building contractors, and in consequence the machinery was not put in operation until nearly the first of September. This, however, was not due to any fault of the company which furnished the machinery. Although the station was designed for four units, only three have as yet been installed, and the fourth will be placed in position when needed.

After operating the station for a short time in a preliminary way to make adjustments properly, it was put in regular service and has been delivering water to the city for about two months. Every one who has been connected with the work has been extremely gratified with the success which has attended this electrical pumping equipment. The pumping units operate with practically no vibration and are easily regulated to maintain any desired pressure.

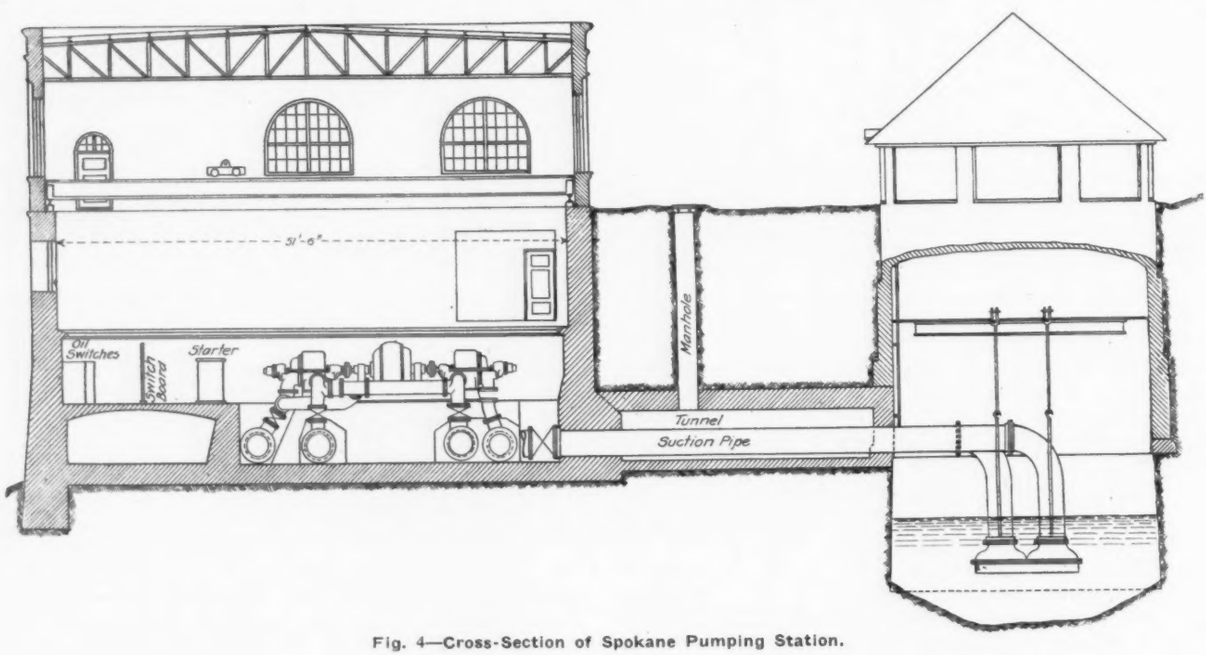


Fig. 4—Cross-Section of Spokane Pumping Station.

Industrial and Commercial News

THE WEEK IN TRADE.

HOLIDAY influences furnished the only encouraging feature to general trade last week. The retailers in every part of the country were busy, but it is doubtful if the volume of holiday business will equal that of last year. In contrast with this activity in retail trade was the almost entire absence of orders among the wholesalers and jobbers. Aside from a few scattered reorders to fill depleted stocks, there was no business done in this branch of trade. Speaking sectionally the trade in Western centers was much better than it was in the East and the agricultural districts were much busier than the industrial. In every part of the country there is a disposition to be conservative and individual purchases are in the majority of instances of less expensive wares than heretofore. Industry is even quieter than in previous weeks. Further curtailments are reported among the iron and steel mills. Many furnaces are banked, yet stocks of pig iron are larger than can be comfortably carried. The mills with the exception of those producing wire are not running at half capacity. This is largely due to the almost entire absence of railroad buying and to the discouraging promises that are made for next year. Lower wages are being talked of as a result of the limited demand for steel products, and this it is feared would be followed by strikes. Business in steel rails is very light. The Baltimore & Ohio Railroad, which bought 80,000 tons last year, will take only half that amount in 1911. This instance is illustrative of the entire situation. It is said that a goodly volume of orders are pending for structural material. Canada has purchased 20,000 tons of steel plates, but domestic orders are slack. Prices both for pig iron and for manufactured products are being shaded according to reports, but these concessions have not as yet been successful in stimulating business. Collections, especially in the West, are somewhat better, due to the freer circulation of money, but bank clearings are smaller than they were the same week last year. Business failures for the week ended Dec. 22, as reported by *Bradstreet's*, were 271, as compared with 290 the previous week, 264 in the same week of 1909, 196 in 1908, 248 in 1907, and 161 in 1906.

THE COPPER MARKET.

DURING last week the copper market was practically a negative quantity. While exports were fairly large, much of the metal shipped represented vious sales. It is undeniable, however, that during the week the demand for foreign account displayed more symptoms of life than the demand from domestic consumers. There was practically no demand from local melters, and while it is understood that the business of the electrical companies and the brass foundries has been good there is no disposition to buy copper. The market is not entirely without hope, however, and it is confidently predicted that during the first quarter of 1911 business will be much more active. Some large cable contracts are expected in this period which may call for more copper, and there is always the hopeful anticipation that some of the important steam railroads will carry out their tentative electrification projects. In the meantime the statistical position of copper continues to be "the fly in the ointment." As long as the production of copper is 25 per cent more than the actual consumption prices will be uncertain and confidence in the future lacking. The National Conduit & Cable Company speaks frankly on this subject in its monthly circular. It says: "The maximum capacity at mines and refineries is developed to a point excessively great, and our domestic demand and foreign trade cannot consume present supplies. The total home consumption attained and the heavy outward movement fail absolutely to use up the available metal. The situation calls for energy and intelligence to bring it into a healthy state. Last month's output from American refineries was 119,353,463 lb., and every one knows that when any article is overproduced such faulty methods prove hurtful in many ways. The legitimate laws of supply and demand and a liquid market are the reliable factors in clearing up the whole situation, and against which there can be no law." Exports for the month, including Dec. 23, were 23,224 tons. The daily call on the Metal Exchange Dec. 23 quoted standard copper as per accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.15	12.25	.....
December	12.15	12.25	12.20
January	12.15	12.25	12.20
February	12.15	12.30	12.22½
March	12.15	12.30	12.22½

The London market, Dec. 23, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	56 12 6	56 12 6
Standard copper, futures	57 7 6	57 7 6

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50c	11.70c
London, spot	£62 0 0	£52 15 0
London, futures	65 18 9	53 7 6
Best selected	65 10 0	57 15 0

INDUSTRIAL AND COMMERCIAL NOTES.

Amador Mines, Power & Water Company.—Articles of incorporation have been filed in California for the Amador Mines, Power & Water Company. The capital stock is to be $300,000. It is given out that the purpose of the company is to construct a storage reservoir at Grass Valley, near Pine Grove, Cal., which will have a large capacity and which will cover an area of 150 acres at a depth of 50 ft. It is also proposed to build an electric power plant on Sutter Creek, about five miles from Jackson. This plant will have an initial capacity of 2000 hp. It is expected that one-half of this energy will be used by the Amador mines, and the other half will furnish power and light for the towns of Jackson, Sutter Creek and Amador City. The plant will be so constructed as to add units sufficient to make an ultimate capacity of 18,000 hp.

Edward E. Cary Company.—The Edward E. Cary Company, 30 Church Street, New York, which has for the past four months been selling the output of the Heinrich Electric Novelty Company in Brooklyn, reports that the demand for novelties for the Christmas trade has been far beyond the capacity of the factory to produce. Not only was this true with regard to Christmas tree decorations, but the demand for flash lights and for pocket electrical novelties was greater than ever before known. The capacity of the factory will be increased during the coming year. Mr. Cary, president of the selling company, says that he has made many excellent contracts during the past few months for the Henrion carbons, and has placed quite a number of large orders for these carbons in South America and Canada. Mr. Cary will sail for Europe early in January to be gone about six weeks.

Damage to New York Central's Substation.—The destructive explosion beneath the substation of the New York Central Railroad, at Fiftieth Street and Lexington Avenue, which occurred Dec. 19, did not in any way damage the transformers or rotary converters in that station. In fact, the rotaries were out of commission only three or four minutes on account of the explosion. The storage-battery room, however, which was immediately over the gas tank, was entirely wrecked, and the damage to this plant will not be fully known until all of the debris has been cleared away and a further investigation has been made. This was the largest storage-battery plant in connection with the New York Central service.

Duplex Metals Company.—The Duplex Metals Company is now fully settled in its new headquarters at Chester, Pa. The chief offices of the company were removed to that city several months ago. The selling office will be continued in the Singer Building, New York City. Sales offices have also been established in St. Louis, Portland, Ore., and Cleveland. Representatives of the company declare that business for the year has been very good and many large orders have been taken. One that was recently placed was for 400 miles of No. 8 wire. The sale was made to the Western Electric Company for railroad telephone work.

Boston Suburban Electric Companies.—At the annual meeting of the Boston Suburban Electric Companiess last week Adams D. Claflin, Charles F. Dennison, Sydney Harwood, Alden E. Viles and William F. Hammett were re-elected trustees. Mr. Claflin was re-elected president.

Large Government Electrical Pumping Contract.—One of the largest contracts for pumping machinery ever placed has just been awarded to the Alberger Pump Company, of New York City, by the Bureau of Yards and Docks, the total sum involved being slightly over $323,000. The contract covers pumping equipment for the three new dry docks to be constructed by the government at New York, Puget Sound and Pearl Harbor navy yards, and includes all told eleven 54-in. vertical volute pumps, each direct-connected to a 550-hp induction motor, and seven 15-in. vertical volute drainage pumps, each direct-connected to an 85-hp induction motor; also all necessary suction and discharge piping, electrically operated gate valves for the same and all electrical controlling apparatus for the motors. Three of the 54-in. units will be located at New York, while four are required for each of the other docks. Each unit is required to operate against a static head, varying from zero when the dock is full to a maximum of 42 ft. to 44 ft. when the dock is completely empty, while operating at a constant speed of 219 r.p.m without exceeding the rated horse-power of the motor at any point. In addition to this, each pump is required to maintain an average capacity of 66,000 gal. per minute when emptying the dock from approximately mean high water to 1 ft. above the elevation of the keel blocks, the static head varying from zero to 32 ft. or 34 ft. Under these conditions the contractor has guaranteed an average efficiency of 45 per cent for New York and Pearl Harbor and 46 per cent for Puget Sound, these efficiencies being the ratio of the actual useful work in pumping the docks to the electrical input to the motors, and consequently including all losses in the motors, pumps and piping. To meet these average efficiencies it is necessary for the pumps themselves to reach a maximum efficiency of nearly 80 per cent. In addition to obtaining a high efficiency, the other characteristics of the pump have to be very carefully determined in order to meet the special conditions involved in this class of work. The Alberger Condenser Company reports that business during the past year has been fairly satisfactory. During the early spring months it was moderately good. Beginning with June, for four months the orders came in more rapidly than they could be filled, and the factory, although run over-time, was still unable to make prompt deliveries. After Oct. 1 the orders were slack until within the past two or three weeks, when they have picked up in a very encouraging manner.

Interurban Railway to Connect Jamestown and Dunkirk, N. Y.—At a recent conference in Jamestown, N. Y., citizens of that city and of Dunkirk and Fredonia conferred with A. N. Broadhead, president of the Jamestown Street Railway Company and the Chautauqua Traction Company, in relation to a proposed electric railway to connect Jamestown to Fredonia and Dunkirk, following the Cassadaga Valley and passing through Ellicott, Gerry, Charlotte, Stockton and Pomfret. Such a line would parallel the Dunkirk, Allegheny Valley & Pittsburgh steam railroad. Preliminary surveys will be made, and Mr. Broadhead is interested in the possibilities of the proposed railway. Jamestown has at present interurban connections with Mayville and Westfield on the north, and with Warren, Pa., on the south. Dunkirk, on the shore of Lake Erie, is connected with Buffalo, Erie and other lake-shore towns by the interurban lines of the Buffalo & Lake Erie Traction Company.

Ontario Power Company.—It is announced that when the construction plans now under way at the plant of the Ontario Power Company, Niagara Falls, Ont., are completed the company will be developing a total of 114,000 hp. This construction work will be completed within a few months. The seven units of the company now in operation are delivering about 70,000 hp. The eighth unit is expected to be in operation within a few days. In connection with its plan to distribute cheap power to Canadian municipalities, the Province of Ontaria has installed a transformer station about half a mile from the Ontario Power Company, and takes energy from the latter by underground cable transmitting 110,000 volts. This reaches the government lines, which distribute to the municipalities throughout the province. This energy is now being used by cities and towns as far west as London, Ont.

Marseilles (Ill.) Hydroelectric Development.—Contracts for the hydroelectric power house of the Northern Illinois Light & Traction Company on the Illinois River at Marseilles, Ill., described in the *Electrical World* of Sept. 29, 1910, have been awarded as follows: Excavating and concrete structure at power-house site, L. E. Myers Construction Company, Chicago; generators, transformers and other electrical equipment, Westinghouse Electric & Manufacturing Company, Pittsburgh; water-wheels, James Leffel & Co., Springfield, Ohio. The Northern Illinois Light & Traction Company is subsidiary to the Western Railway & Light Company (McKinley system), and H. E. Chubbuck, general manager of the latter company, supervised the placing of the contracts. Mr. C. N. Humphrey, Chicago, is the consulting engineer.

Rapid Transit for Westchester County.—It was officially stated last week at a dinner of the Putnam Association, an organization formed of residents along the Putnam Division of the New York Central Railroad in Westchester County, that the railroad company had completed plans for the electrification of a portion of that division as soon as the new Grand Central Station in New York City has been completed. It is proposed to double-track the line and to bring the trains, which now run only to 155th Street, down to the Grand Central Station. It was also suggested at the same dinner that ultimately Interborough Rapid Transit trains would run over a portion of the Putnam Division.

Motors for Oil Well Drilling.—The Westinghouse Electric & Manufacturing Company has recently been testing, and will soon install, a new type of electric motors on the oil producing property of the Santa Fé Railroad, near Bakersfield, Cal. These motors will be installed just as soon as the Joaquin Light & Power Corporation builds its new transmission line through the Bakersfield district. The motors are of the constant-speed type, similar to those used by the South Penn Oil Company in West Virginia, and the tests are said to have proved entirely satisfactory, both to the Westinghouse engineers and to the Santa Fé officials.

Bankruptcy Legislation.—Louis Starr, merchant of Boston, writes urging the desirability of all business men lending assistance in securing the passage through Congress of an adequate bankruptcy law. The present law, he says, should be so amended that an individual or firm becoming financially embarrassed in business may, by petition of a creditor or by voluntary act, become the direct subject of the court. This would eliminate all the demoralizing and costly go-between red-tape procedure of lawyers, keepers and receivers, who absorb the bulk of the assets which should go to the creditors.

Electrification of Chicago Railroads.—A special committee of the Chicago Association of Commerce, which has for a year been investigating the feasibility of electrifying the steam railroads of Chicago, has reached the conclusion that there is absolutely nothing to prevent this work except the unwillingness of the railroads to incur the expense. The railroad officials, however, are unanimous in the opinion that they cannot bear this expense at the present time. They all agree that electrification would be a good thing, but that at the present time it is financially impossible.

British Columbia Electric Company.—The British Columbia Electric Company, Ltd., of Vancouver, has made an offer to the Western Canada Power Company to purchase the latter on a basis of guaranteeing its bonds and also a 5 per cent dividend on the common stock. The Western Canada Power Company, which has been for some time constructing a hydroelectric plant on Stave River, 35 miles east of Vancouver, will generate, when this development is completed, 52,000 hp. This plant is expected to be in operation some time next spring.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at East St. Louis, Ill.; Bangor, Maine; Webster, Mass.; Valparaiso, Ind.; Portland, Ore.; Douglas, Ariz.; Moberly, Mo.; Plattsburg, Mo.; Darby, Pa.; White Plains, N. Y.; Maricopa, Cal.; Sausalito, Cal.; Rocky Ford, Ga.; Guthrie, Okla.; Wakefield, Mass.; Chehalis, Wash.; Oroville, Cal.; Gardnerville, Nev.; Pocatello, Idaho, and Colliersville, N. Y.

Northern Indiana Interurban Railway.—Plans are being developed for an electric interurban railway to connect the industrial centers of Lake County, Ind., and Chicago. C. H. Geist, of Philadelphia, formerly of Chicago, is said to be interested in the project. The line, if built, will be about sixty miles long, and will connect East Chicago, Indiana Harbor and other points along the southern shore of Lake Michigan.

Financial.

THE WEEK IN WALL STREET.

PROBABLY Wall Street has never experienced, in recent years at least, a more disappointing week or a more apathetic group of traders than that which immediately preceded the Christmas holiday. For the five days of that week the total sales of shares were only 1,421,229, and on the last day before adjournment but little more than 100,000 were sold. It has been the history of the Street that the last weeks of the year have been marked by activity and frequently by an advancing market. Many of the older traders laid their plans

NEW YORK.

	Dec. 19.	Dec. 23.	Shares Sold		Dec. 19.	Dec. 23.	Shares Sold
All. Ch.....	8¼*	8⅜*	100	Int. Met., pf.	56	54¼	12,500
Al. Ch., pfd.	30	30*	500	Mackay Cos.	88*	92½*	100
Amal. Cop...	64¾	62⅝	28,800	Mackay, C.,pf	74¾	76*	400
Am. D. T...	20½*	20½*	———	Man. Elev...	138*	139*	400
Am. Loco....	37⅞	36½	800	Met. St. Ry..	15*	15*	———
Am. Loco.,pf.	106*	105½*	120	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	80*	80*	———	Steel, Com...	73⅜	72⅛	243,410
Am. T. & T..	141¾	142½	7,800	Steel. pfd....	116¾	116⅞	1,840
B. R. T.....	75½	75½	11,320	W. U. T....	74⅛	73	5,615
Gen. Elec....	155⅞	155	2,925	West'h, com.	67⅛	66½	1,000
Int.-Met.	20¾	19½	6,900	West'h, pfd..	122*	122*	100

PHILADELPHIA.

	Dec. 17.	Dec. 23.		Dec. 17.	Dec. 23.
Am. Rys.....	42½	42½*	Phila. Elec.....	15⅞	16¼
Elec. Co. of A.....	11⅝*	11⅝*	Phila. R. T.....	18⅝	18¼
Elec. St. B'ty.....	49⅜	48¾	Phila. Trac.....	83⅜	84*
E. S. B'ty., pfd.....	30*	30*	Union Trac.....	43¼	43

CHICAGO.

	Dec. 17.	Dec. 23.		Dec. 17.	Dec. 23.
Chi. City Ry.....	170*	170*	Chi. Tel. Co.....	123	123
Chi. Rs., Ser. 1....	91*	92½*	Met. El. Co.....	21	21*
Chi. Rs., Ser. 2....	25¾	25¼	Met. El., pfd.....	65*	65*
Com. Edison.....	115½	115½	Nat'l Car.....	120*	117
Chi. Subways.....	4⅛	4	Nat'l Car., pfd.....	117½	117½*

BOSTON.

	Dec. 17.	Dec. 23.		Dec. 17.	Dec. 23.
Am. T. & T.....	142⅛	142½	Mex. Tel.....	4	4*
Cum. Tel.....	151	149*	Mex. Tel., pfd.....	6¼*	6⅜
Edison E., Ill.....	282*	285	N. E. Tel.....	138*	138
Gen. Elec.....	156¼	155*	W. T. & T.....	16*	16*
Mass. E. Ry.....	17⅜*	18¼*	W. T. & T., pfd....	90	90¼*
Mass. E. Ry., pfd...	85	85½*			

*Last price quoted.
Shares sold for five days, Dec. 19 to Dec. 23.

in anticipation of this, only to be disappointed. Those who had accumulated holdings that were to be liquidated during the holiday activity found that there were no buyers and that unless they were willing to accept losses they must carry their lines over into the new year, where the sailing is likely to be squally. It is evident, however, that the accounts carried by professional traders are abnormally small. The market has been well liquidated and the short interest is extremely light. This is but another demonstration of the unsettled and uncertain condition of the market. Even the most daring of the speculators have been disposed to go slowly. There is a vast amount of uncertainty as to what the new year will develop. Within a few weeks after 1911 is ushered in we may expect Supreme Court decisions in the important trust cases and probably a decision in the railroad rate case. It is felt in Wall Street that upon these decisions hangs the fate of the financial market—if not the entire commercial business—for the coming year. Adverse decisions will surely be followed by a slump in prices and probably a prolonged period of liquidation; favorable decisions will certainly do much to restore confidence among the regular market traders and possibly might develop the courage of the public to the point of inducing it to buy stocks. The only bright spot in the recent market has been the improved demand for high-class bonds. Much of the money that ordinarily would be used in stock deals has found its way into bonds. The money market in the meantime continues to be very easy, with the banks well supplied with funds. Rates Dec. 23 were: Call, 3 @3½ per cent; ninety days, 4 per cent. The quotations in the table are those of the close Dec. 23.

FINANCIAL NOTES.

Montreal Tramways & Power Company.—It has been officially announced in Montreal that the object of the Montreal Tramways & Power Company, Ltd., which was recently organized in London with a capital of $20,000,000, as referred to in the issue of Dec. 22, is to take over control of the Montreal Street Railway and Canadian Light & Power Companies. President Robert of the Street Railway company has made this statement concerning the project: "Several months ago the Imperial Trust Company was organized with a large capital paid up in cash to finance the acquisition of a majority of the shares of the Montreal Street Railway Company. It secured the co-operation of certain English capitalists, and it was the intention at the outset to obtain control also of a majority of the stock of the Canadian Light & Power Company. One of the objects of the Montreal Tramways Company is to purchase the present holdings of the Imperial Trust Company and eventually acquire a majority of the shares of the Montreal Street Railway Company and the Canadian Light & Power Company and finance these two companies with English capital. The two companies will retain their separate and distinct identities, operating their own plants and working under their respective franchises and be subject as heretofore to all legislative enactments and municipal regulation. It is the object of the organizers of the new company to procure through the medium of a holding company these two properties, so that they shall in future operate in entire harmony. The railway will always have an independent supply of energy and the generating company will always have a customer for its energy."

Interborough Financing Plans.—While no official announcement has been made of the financial plans of the Interborough Rapid Transit Company in connection with the construction of additional subways and elevated lines in New York City, the program of the company has been unofficially discussed. The plan will call for the retirement of the $55,000,000 first mortgage bonds issued for the redemption of outstanding obligations and still held in the treasury. A new issue of $150,000,000 new bonds will be made, covered by a blanket mortgage over all of the Interborough property. This new issue will be used as follows: $75,000,000 for additional subways; $32,000,000 for elevated extensions; $35,000,000 for the retirement of outstanding bonds; $4,584,000 for the redemption of Interborough notes, making a total of $146,584,000. It is also said that if the plans for extensions are approved by the city, there will be a number of changes in the Interborough-Metropolitan board. In fact, these changes may be made at the annual meeting, Jan. 17, under any circumstances.. Several of the directors now on the board will resign, and these will be replaced by representatives of J. P. Morgan & Company.

Rochester Traction Consolidation.—Charles D. Beebe, president of the Rochester, Syracuse & Eastern Railroad, has made the announcement that he and a number of associates have purchased the Buffalo, Lockport & Rochester Railway Company. In the last issue was published the report that these two railway properties had been purchased by the New York Central Railroad or interests identified with it. Mr. Beebe states that the lines will be operated separately by himself and independent associates. Securing this property gives the Beebe interests direct connection between Syracuse and Buffalo. The price paid for the Buffalo, Lockport & Rochester property is not given out, but is said to be something like $6,000,000.

Long Acre Electric Light & Power Company.—There were two hearings before the Public Service Commission of the First District last week upon the application of the Long Acre Electric Light & Power Company for permission to issue $10,000,000 stock and $50,000,000 bonds. Attorneys for the New York Edison Company made a vigorous attack on the Long Acre's right to operate under its franchise, Representatives of the Long Acre company contended that the Edison company had no standing in the proceedings and declared that that company was a monopoly and simply seeking to choke off competition. Hearings were continued until Jan. 4.

Springfield (Ohio) Light, Heat & Power Company.—O'Connor & Kahler, bankers of New York and Chicago, are offering an issue of $250,000 first mortgage 5 per cent bonds of the Springfield Light, Heat & Power Company. These bonds are offered at 97½ and interest. In addition to controlling the entire electric light and power business of the City of Springfield, the company owns a power plant located on the main line of the Detroit, Toledo & Ironton Railway. The company also has a system of steam heating mains, through which heat is served to city consumers.

Pensacola Electric Company.—Stone & Webster, Boston, are offering $250,000 of five year 6 per cent convertible gold coupon notes of the Pensacola Electric Company at 97¾. These notes are convertible at the option of the holder into common stock at par after March 1, 1912. The proceeds from the sale of this issue will provide funds for the retirement of the company's floating indebtedness, which was incurred for additions and improvements to the property necessary to meet the increased demands of new business.

Chicago Railways Consolidation.—It is expected that the receivership of the Chicago Railways Company will be lifted within a few days, and it is not believed that a new injunction will be asked for. The hearing on the present injunction comes up in January. Henry A. Blair, who is at the head of the syndicate negotiating the merger of the Consolidated Traction and Chicago Railways properties, says that this merger will be consummated early next month. "We are now in first class shape to have everything cleared up before the first of the year," said Mr. Blair, "and the Railways Company will be taken out of the hands of the receiver. I think that within a few days we shall have but one street car company controlling all the lines on the north and west sides of the city. The Chicago Railways Company has carried out its bargain with the city to the letter, and the new cars for the Consolidated lines have already been ordered. The weather has stopped rehabilitation work, but from the time the extension ordinance was passed until the snow came we worked day and night, and made a record for railroad building. Work will be resumed as soon as the weather will permit." The Cook County Traction Company has been organized by Chicago Railway interests to take over all of the Consolidated lines lying beyond the city limits.

Hartwick Power Company.—The Public Service Commission of the Second District of New York has authorized the Hartwick Power Company in Otsego County to execute a mortgage to the Trust Company of America to secure an issue of $750,000 of thirty-year 5 per cent bonds. The company is authorized to issue at once $400,000 of these bonds to be sold at not less than 80, also to issue capital stock to the amount of $300,000. The proceeds of these issues are to be used in payment to the Susquehanna River Power Company for the purchase of the hydroelectric development at Colliers, Otsego County.

Montreal Light, Heat & Power Buys Shawinigan Stock.—The sale of 5000 shares of stock of the Shawinigan Water & Power Company to the Montreal Light, Heat & Power Company has been confirmed. The figures have not been given out, but it is admitted that a premium was paid for the shares. This transaction indicates closer relations between the two companies, as the Shawinigan company some time ago acquired 10,000 shares of Montreal Power stock, and President J. E. Aldred of the Shawinigan company was elected a director of the Power concern.

Central Station Growth at Salem, Mass.—The returns of the Salem (Mass.) Electric Lighting Company to the State authorities for the year ended June 30, 1910, show a gratifying increase in business in comparison with 1909. The total income was $190,226, representing a gain of 11.5 per cent in earnings over 1909. The principal source of increase was the company's electric power business, which gained 51 per cent over the preceding year. Sales of energy for motor service aggregated $36,467.

New York Power Companies Consolidate.—Announcement has been made that the Schoharie (N. Y.) Light & Power Company, the Cairo (N. Y.) Light & Power Company, the Catskill Illuminating & Power Company and the Upper Hudson Electric Company, Coxsackie, N. Y., will shortly be merged. All of these companies have been controlled by the Stevens family, of Hoboken, N. J.

Ohio Traction Consolidation.—It is reported at East Liverpool, Ohio, that New York financiers have brought about a consolidation of all of the traction interests between Pittsburgh and Cincinnati. These include the Ohio Valley Scenic Railway Company, the Tri-State Railway Company and the Panhandle Traction Corporation. Details of this merger have not been given out.

DIVIDENDS.

American Telephone & Telegraph Company, quarterly, 2 per cent, payable Dec. 31.

Bangor Railway & Electric Company, quarterly, 1¾ per cent, payable Jan. 1.

Carolina Power & Lighting Company, Raleigh, N. C., preferred, quarterly, 1½ per cent, payable Jan. 2.

Central & South American Telegraph Company, quarterly, 1½ per cent, payable Jan. 9

Chicago City & Connecting Railways Company, preferred, $2.25 per share; common, $1 per share.

Cincinnati & Suburban Telephone Company, quarterly, 2 per cent, payable Jan. 4.

Cumberland Telephone & Telegraph Company, quarterly, 2 per cent, payable Jan. 2.

Demerara Electric Company, quarterly, 1¾ per cent, payable Jan. 2.

Electrical Securities Company, quarterly, preferred, 1¼ per cent, payable Feb. 1; common, 2 per cent, payable Dec. 31.

Electric Storage Battery Company, quarterly, 1 per cent, preferred, 1 per cent, common; both payable Jan. 3.

Electrical Utilities Corporation, quarterly, preferred, 1¼ per cent, payable Jan. 16.

El Paso Electric Company, semi-annual, 3 per cent; payable Jan. 9.

Empire District Electric Company, monthly, preferred, ¾ per cent, payable Jan. 1.

Halifax Electric Tramways Company, quarterly, 1¾ per cent, payable Jan. 3.

Kansas Gas & Electric Company, preferred, quarterly, 1¾ per cent. payable Jan. 3.

Massachusetts Lighting Companies, quarterly, 1¾ per cent, payable Jan. 16.

Mexican Telegraph Company, quarterly 2½ per cent, payable Jan. 16.

Michigan Light Company, preferred, quarterly, 1½ per cent, payable Jan. 3.

Pacific Telephone & Telegraph Company, preferred, quarterly, 1½ per cent, payable Dec. 31.

Terre Haute, Indianapolis & Eastern Traction Company, preferred, quarterly, 1¼ per cent, payable Dec. 31.

Tri-City Railway & Light Company, preferred, quarterly, 1½ per cent, payable Jan. 3.

Union Railway, Gas & Electric Company, quarterly, preferred, 1½ per cent, payable Jan 3.

Union Gas & Electric Company, semi-annual, preferred, 2½ per cent. payable Jan. 14.

United States Light & Heating Company, preferred, semi-annual, 3½ per cent, payable Jan. 15.

Westinghouse Electric & Manufacturing Company, preferred, quarterly, 1¾ per cent, payable Jan. 16.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
Central & South American Telegraph Company:					
Quarter ended Dec. 31, 1910 (est.)	$435,500	$165,000	$270,500	.....	.....
Quarter ended Dec. 31, 1909	445,500	167,000	278,500	.....	.....
Edison Electric Illuminating Company of Boston:					
November, 1910	485,156	197,909	287,247	.....	.....
November, 1909	456,089	183,771	272,318	.....	.....
Interborough Rapid Transit Company:					
November, 1910	2,558,279	984,727	1,573,553	$886,445	$561,631
November, 1909	2,459,767	887,071	1,572,698	881,070	598,866
Kansas City Railway & Light Company:					
November, 1910	644,416	381,401	263,014	188,643	74,371
November, 1909	607,167	352,219	254,948	171,429	83,518
Mexican Telegraph Company:					
Quarter ended Dec. 31, 1910 (est.)	205,000	37,500	167,500	.....	.....
Quarter ended Dec. 31, 1909	195,000	37,500	157,500	.....	.....
Montreal Street Railway Company:					
November, 1910	366,098	227,441	138,656	32,031	106,643
November, 1909	334,871	200,137	134,733	30,803	103,948
Rio de Janeiro Tramway, Light & Power Company:					
November, 1910	946,006	460,201	485,805	.....	.....
November, 1909	632,568	355,396	277,142	.....	.....
Sao Paulo Light & Power Company:					
November, 1910	259,390	89,066	170,324	.....	.....
November, 1909	221,064	80,062	141,002	.....	.....
Susquehanna Railway, Light & Power Company:					
Year ended Oct. 31, 1910	844,592	.....	.....	249,849	594,742
Year ended Oct. 31, 1909	672,198	.....	.....	248,793	423,405
Washington, Baltimore & Annapolis Electric Railway Company:					
November, 1910	53,747	29,798	23,948	.....	.....
November, 1909	49,938	28,803	21,135	.....	.....

General News

Construction News.

ALBERTVILLE, ALA.—The proposition to issue $7,000 in bonds, the proceeds to be used for the construction of an electric light plant, will be submitted to a vote.

BISBEE, ARIZ.—The City Council is reported to be considering the installation of a municipal electric light plant.

DOUGLAS, ARIZ.—Bids will be received by R. G. Arthur, secretary Board of Water Commissioners, about the middle of January for the construction of an electric light plant and water works system in Douglas, to cost about $85,000. E. T. Archer & Company, of Kansas City, Mo., are engineers.

PHŒNIX, ARIZ.—The Board of Supervisors has granted the Glendale Electric Company, an extension of the Phœnix Street Railway Company, a franchise to cross the county roads from Phœnix to Glendale. The company has secured a private right of way.

MURFREESBORO, ARK.—W. A. Fuller, 1616 Chemical Building, St. Louis, Mo., is engineer in charge of the construction of the proposed power plant of the Pike County Water Company. The cost of the work is estimated at about $850,000. As yet no definite plans have been announced.

MARICOPA, CAL.—The Midway Light & Power Company has established a twenty-four-hour service from its Maricopa plant. The company was recently incorporated with a capital stock of $250,000 and has taken over the plant and holdings of the West Side Electric Company, of Maricopa, and proposes to double the output of the plant immediately. Orders for equipment have already been placed. An auxiliary steam power plant will be installed at Taft.

OROVILLE, CAL.—Announcement has been made by the Oro Water, Light & Power Company that extensive improvements will be made to its local water, electric and gas distributing systems during the next year, which will involve an expenditure of about $70,000. R. L. Van der Naillen is manager of the company.

PLACERVILLE, CAL.—Notice of appropriation of 9000 in. of water flowing in the south fork of the American River has been filed by Henry Lahiff. The water is to be used for manufacturing purposes and for generating electricity.

QUINCY, CAL.—The Board of Supervisors of Plumas County will receive bids until Jan. 6 for the franchise applied for by the Portola Electric Light & Power Company to erect transmission lines to transmit electricity on the streets and highways of Beckworth and Quartz townships. L. G. Lane, Charles Fyre and W. J. Crawford are interested in the company.

SACRAMENTO, CAL.—The Sacramento Electric, Gas & Railway Company has applied to the City Council for a twenty-five year franchise for an extension of its system in this city.

SACRAMENTO, CAL.—The Home Telephone Company, which is operating in San Francisco and the Bay cities, contemplates asking for a franchise in Sacramento and other towns in the Sacramento Valley. The company proposes to erect long-distance lines connecting the principal cities in the valley.

SAN FRANCISCO, CAL.—The Columbia Marble Electric Company, of San Francisco, Cal., is reported to be considering the installation of a Fort Wayne electric drill at its quarry.

SAN FRANCISCO, CAL.—Application has been made to the Park Commissioners, by Willis Polk, in behalf of the Great Highway Development Company, for a franchise to construct and operate a miniature railway on the great highway from the Cliff House to Sloat Boulevard, a distance of three miles. He states that the road would cost more than $300,000 and the fare would not be in excess of 5 cents for each passenger. He also offered to turn over the railroad tracks and equipment to the city when the company is repaid for its outlay, with a fair rate of interest. The commission has taken the matter under consideration.

SAN LUIS, CAL.—A. M. Bianchi, of Cayucos, and James E. McFee are interested in a project to construct an electric railway from San Luis Obispo to San Simeon, and from Cayucos to Paso Robles.

SANTA BARBARA, CAL.—Contracts have been placed by the Santa Barbara Gas & Electric Company for the erection of three new buildings in connection with its plants in this city. One will be erected on Castillo Street, at a cost of $8,000, the second on Quarantiana Street, to cost $7,000, and a small building will be built on Montecito Street.

SAUSALITO, CAL.—The Northwestern Pacific Railway Company is reported to be in the market for a 2000-kw, direct-current railway generator set for its Alto power station.

DANIELSON, CONN.—Plans have been practically completed by the People's Light & Power Company, of Danielson, for extending its transmission lines to Elmville and Dayville to supply electricity in both villages. Arrangements have been made to install street lamps in Dayville.

MOODUS, CONN.—Application has been made for charter by the Moodus & East Hampton Electric Railway Company to build an electric railway to connect Moodus, East Hampton and Marlboro Mills.

NEW BRITAIN, CONN.—Frank F. Hanford and Charles F. Lewis, of Berlin, Conn., are interested in a project to build an electric railway between New Britain and Meriden. A charter will soon be applied for.

NEW HAVEN, CONN.—The Shore Line Electric Railway Company, which operates an electric railway from Stony Creek along the shore to Saybrook, and thence to Essex and Ivoryton, will petition the next General Assembly to amend its charter, giving it the right to supply electricity from its power house for lamps and motors in the towns of Old Saybrook, Westbrook, Essex, Madison, Guilford, Branford and North Branford, and to build spur tracks from its present line to carry freight and passengers within the above territory. The company proposes to supply electricity for manufacturing purposes.

NORWICH, CONN.—The Board of Gas and Electric Commissioners has decided to install a 750-kw steam turbo generator set and make other improvements to the municipal electric light plant, for which an appropriation of $35,000 was recently made.

OAKVILLE, CONN.—Negotiations are under way between the lighting committee of the Oakville Lighting District and the Housatonic Power Company for lighting the town. It is proposed to install not less than forty 20-cp incandescent lamps, for which the district is to pay $15 per lamp per year.

MADISON, FLA.—The question of establishing a municipal electric light plant in Madison is reported to be under consideration. It is proposed to purchase the plant owned by the Madison Electric Power Company.

AUGUSTA, GA.—The Augusta-Aiken Railway & Electric Company will purchase through the J. G. White Company a large quantity of equipment, machinery, etc., for power plant, including turbines, motor generator sets and switchboards.

ROCKY FORD, GA.—The Ogeechee River Electric Company has applied to the Railroad Commission of Georgia for authority to issue $1,500,000 in capital stock and $1,500,000 in bonds. The company proposes to construct three reinforced dams and three power houses on the Ogeechee River, one to be located at Rocky Ford, another at Scarboro and the third near Oliver, Ga.

POCATELLO, IDAHO.—Announcement has been made that the Idaho Consolidated Power Company is contemplating the construction of a new power house at American Falls and will develop 30,000 hp additional during the coming year.

BELVIDERE, ILL.—It is reported that petitions are being circulated asking for an election to be called to vote on the proposition to establish a municipal electric light plant.

EASTON, ILL.—It is reported that F. H. Conroy and Roy Holly will apply to the Village Board for a franchise to establish an electric light system in Easton.

EAST ST. LOUIS, ILL.—Preparations are being made by the East St. Louis & Suburban Railway Company for the construction of a power plant at Reeb Station, St. Louis, work on which will begin at once. The proposed plant will supply electricity for the Belleville City railway and additional power for the suburban system between Belleville and East St. Louis. C. F. Hewitt is superintendent.

KANSAS, ILL.—The Village Board is reported to have accepted the proposition of the Central Illinois Public Service Company, of Mattoon, Ill., to purchase the municipal electric plant. It is proposed to operate the plant independently until the proposed interurban railway from Charleston, through Kansas to Paris, is completed. Electrical service will then be supplied from the Central power plant.

KEITHSBURG, ILL.—The commissioners of the Keithsburg Drainage District have awarded the contract for furnishing two electrically driven centrifugal pumps to the Erie City Iron Works, represented by W. A. Day & Company, of Chicago, Ill.

MORRISONVILLE, ILL.—The capital stock of the Morrisonville Electric Company has filed an amendment to its charter increasing its capital stock from $6,000 to $15,000.

OLNEY, ILL.—The Egyptian Packing Company is reported to be in the market for equipment for an electric light plant, to include a 35-kw direct-current, 110-volt direct-connected generator and engine, also one 20-hp motor and one 5-hp motor.

INDIANAPOLIS, IND.—The Board of Public Works has contracted with the Indianapolis Light & Heat Company to supply incandescent electric lamps to be used as an auxiliary to the present arc lamp street lighting system. The board has placed an order for 150 tungsten lamps, some of which will be installed immediately and the remainder next year. Under the company's franchise it agreed to furnish incandescent street lamps of not less than 50 cp at a cost of $35 each per year. The company refused to make a contract for the 75-watt lamp at a lower price, but has agreed to supply a sufficient number to bring the price down to

$27.25 per lamp per year. Under the present contract the company supplies arc lamps at the rate of $75 each per year.

VALPARAISO, IND.—The Valparaiso & Northern Railway Company has entered into a contract with the Northern Indiana Gas & Electric Company to supply electricity to operate its railway and the La Porte-Gary division of the Chicago-New York electric air line railroad for a term of ten years. A substation equipped with three 300-kw converters will be erected at the junction of the two lines. It is expected to have cars operating between La Porte and Chesterton, Ind., by Feb. 1, 1911, or soon after, using 1200 volts and securing power from a temporary station until the substation is completed. Lewis E. Woodward is secretary.

CLEAR LAKE, IA.—The Town Council has authorized the installation of ornamental lamps on five blocks, eight to the block, to cost $65 per lamp standard.

INDEPENDENCE, IA.—The farmers have petitioned the City Council for an extension of the municipal electric light service.

KEOKUK, IA.—The Mississippi River Power Company, recently incorporated, is constructing a large hydroelectric power plant on the Mississippi River, at Keokuk. The work includes the construction of a dam, locks, power house, etc. The Stone & Webster Engineering Corporation, of Boston, Mass., has charge of the work.

INMAN, KAN.—The installation of an electric light system in Inman is reported to be under consideration. It is proposed to secure electricity for operating the system from the electric plant in McPherson, Kan.

SCOTTSVILLE, KY.—The capital stock of the Settle & Gainesville Telephone Company has been increased from $7,500 to $17,500.

ALEXANDRIA, LA.—The City of Alexandria is reported to be negotiating for the purchase of the property of the Alexandria Electric Street Railway Company. If the city takes over the railway it will be operated in connection with the municipal electric light and power plant. If the deal is consummated the proposition will be submitted to a vote of the people.

NAPOLEONVILLE, LA.—The water works and electric light committee has recommended to the City Council that immediate repairs be made to the water works plant. A new pump will be purchased and a pipe line running to the bayou will be started.

BANGOR, MAINE.—The Bangor Railway & Electric Company is contemplating extensive plans for electric railway and electrical power development in the vicinity of Bangor. It is proposed to rebuild the old Veazie dam on the Penobscot River, above Bangor, or else to build a dam at or near Basins Mills.

ANNAPOLIS, MD.—The contract for construction of power plant for the United States Naval Academy, at Annapolis, Md., has been awarded to the Evans-Almiral Company, of New York, N. Y., for $90,545.

BALTIMORE, MD.—The contract for wiring the sewage pumping station on East Falls Avenue has been awarded to the Central Electric Company at $3,526.

OELLA, MD.—W. J. Dickey & Sons, owners of the Oella Mills, are reported to be considering the construction of a dam on the Patapsco River, about 200 ft. long and 26 ft. high, to develop about 1000 hp.

POOLESVILLE, MD.—The Poolesville Telephone Company is contemplating extending its telephone lines and making other improvements to its system.

SALISBURY, MD.—The Wicomico Electric & Power Company has filed preliminary plans for approval with the Public Service Commission of Maryland, providing for the construction of an electric railway from Salisbury to Nanticoke Point. M. V. Brewington is president.

SHARPTOWN, MD.—Preparations are being made for the installation of an electric lighting system in Sharptown. Electricity for operating the system will be supplied from the electric plant in Baurel.

BOSTON, MASS.—The contract for the heating, ventilating and electrical work for the Physicopathic Hospital has been awarded to Lynch & Woodward for $54,787.

NEWBURYPORT, MASS.—In a decision handed down by the State Board of Gas and Electric Commissioners a reduction is ordered in the price of electricity for lamps in Newburyport from 20 cents per kw-hour to 14 cents per kw-hour, and the rate for gas to be reduced from $1.40 to $1.35 per 1000 cu. ft., to go into effect on Jan. 1, 1911.

WAKEFIELD, MASS.—Plans are being made for the installation of a larger generator in the municipal electric light plant to meet the increasing demands for electricity. The commissioners state that it will soon be necessary to install a new plant, costing from $25,000 to $75,000.

WEBSTER, MASS.—Extensive improvements and extensions are being made to the plant of the Webster & Southbridge Gas & Electric Company, which will include the installation of a new switchboard and a 1,000-kw steam turbine. The floor space of the power house will be double. Contracts have already been placed for the machinery. The cost of the work is estimated at $40,000. The company supplied electrical service in the towns of Webster, Dudley, Oxford, Southbridge and Sturbridge.

WEYMOUTH, MASS.—The Weymouth Light & Power Company has applied to the Massachusetts Gas and Electric Light Commission for permission to issue $210,000 in additional capital stock.

MACKINAC ISLAND, MICH.—The plant and holdings of the Municipal Water, Light & Power Company, of Mackinac Island, Mich., are reported to have been purchased by A. J. Doherty, of Clare, Mich., and D. D. Aitkin, of Flint, Mich. The property includes the electric lighting, water and sewerage systems of Mackinac Island.

BRAINERD, MINN.—Work has commenced on the construction of an electric light and power plant in Brainerd. The Toltz Engineering Company, of St. Paul, Minn., has the contract. It is expected to have the plant completed by March 1.

BROWN VALLEY, MINN.—The proposition to issue $10,000 in bonds for the installation of an electric light plant, it is reported, will be submitted to a vote.

DULUTH, MINN.—The Duluth Canal Power Company is reported to be contemplating the construction of an 80,000-hp hydroelectric plant at Ironton, near Cloquet, Minn. Electricity generated at the plant will be transmitted to Duluth, Minn., and Superior, Wis.

FERGUS FALLS, MINN.—The new switchboard in the exchange building of the Northwestern Telephone Exchange Company was recently destroyed by fire, causing a loss of about $15,000.

FOLEY, MINN.—The installation of an electric light plant in Foley is reported to be under consideration.

MANKATO, MINN.—The Mankato Electric Traction Company is reported to be contemplating the extension of its railway from Mankato to St. Peter, via Kasota, a distance of about twelve miles. H. E. Hance is general manager.

MINNEAPOLIS, MINN.—The Minneapolis, St. Paul, Rochester & Dubuque Traction Company is reported to be contemplating the construction of a power house in South Minneapolis, Minn. The company is now operating gasoline cars.

PINE CITY, MINN.—R. P. Allen, general manager of the Eastern Minnesota Power Company, writes that work on its proposed hydroelectric plant will begin in the spring. The initial installation will have an output of 1000 kw, with provision for 1000 kw later. Transmission lines will be erected to Braham, Hinckley and other points. About 100 miles of line will be erected.

VICKSBURG, MISS.—Sealed proposals will be received at the United States Engineer Office, Vicksburg, Miss., until Jan. 18, 1911, for steel hull, self-propelling hydraulic dredge, steel pontoons and pipe line, and also component groups thereof, including steel dredge hull, steel pontoons and pipe line, upper works, steam plant, propelling machinery, electric plant, pumping engine, condenser plant and evaporator, sand pump, suction pipe and ladder, cutter head, gear and engine, winches and refrigerating plant.

IRONDALE, MO.—Arrangements are being made by James P. Ward, of Irondale, Mo., for the construction of an electric railway, 200 miles in length, work on which will begin as soon as plans are completed.

LINN CREEK, MO.—It is reported that the Big Niangua Hydro-Electric Company will start surveys in January in connection with its proposed hydroelectric power plant. The work will include the construction of a dam to cost $900,000. The cost of the entire plant, including dam, machinery, transmission lines, etc., is estimated at $2,000,000. About 22,000 hp will be developed. Roland E. Brunner, of Kansas City, Mo., is interested in the project.

MOBERLY, MO.—It is reported that plans are being considered for an addition to the water works system and the erection of an electric light plant in Moberly. L. G. Knapp & Company, of Kansas City, Mo., are engineers. Rolla Rothwell is Mayor.

PLATTSBURG, MO.—Preliminary plans are being prepared for the construction of a municipal electric light plant and water works system for the City of Plattsburg, to cost about $50,000. Rollins & Westover, Beals Building, Kansas City, Mo., engineers, are preparing plans.

FALLON, NEV.—The City Council is reported to be considering plans for the installation of an electric generating plant in connection with the water and sewerage systems.

GARDNERVILLE, NEV.—William Hansberg, owner of the property known as the Duncan Ranch, is making preparations for the installation of an electric plant this season. Five thousand feet of pipe line will be required, besides open flumes to tap some of the large springs at the base of the mountain.

EAST JAFFREY, N. H.—At a special election to be held soon the citizens will vote on the proposition of petitioning the incoming Legislature for a charter enabling the town to construct and operate a municipal electric plant.

PENACOOK, N. H.—The Penacook Electric Light Company is contemplating extending its transmission line southward on the river road from its present terminus at the Galvin estate to Riverhill, to supply electricity to the summer residents. It is possible that electric lamps will be erected along the river bank.

CARTHAGE, N. M.—Messrs. Stackhouse & Brown, of Carthage, N. M., have submitted a proposition to the federal government to extend an electric transmission line from their power plant at Carthage to the site of the proposed Elephant Butte dam and to supply electricity for carrying on the construction work there, and to provide electricity for lighting the construction camp. The proposed line will be seventy-five miles in length. A power plant will be erected for this special purpose and to provide electrical power for the Kelly and Mogollon mining districts.

PARMINGTON, N. M.—Investigations are being made by J. A. Clay, general manager of the Durango Electric Company and San Juan Water

& Power Company, in Farmington, with a view of extending the electric transmission lines of the companies to this locality to supply electricity to operate the irrigating pumping plants and for other purposes. It is reported that it is proposed to take over the Farmington electric light plant.

LAS CRUCES, N. M.—The Las Cruces Electric Light & Ice Company has extended its electric lighting system to the town of Mesilla Park.

LAS CRUCES, N. M.—At a recent meeting of the Elephant Butte Water Users' Association held in Las Cruces, President H. B. Holt officially reported that the federal government has embraced in its plans for the construction of the large dam and land reclamation enterprise in the upper valley of the Rio Grande the installation of a hydroelectric plant, which will utilize the maximum amount of power afforded by the water storage reservoir. Electricity generated at the plant will be transmitted throughout the valley for use of the farmers.

ALBANY, N. Y.—The contract for construction of hydroelectric plant at the Crescent dam has been awarded to the Wells-Boughton Company, of Troy, N. Y., for $42,940, by F. C. Stevens, superintendent of the State Department of Public Works.

ALBANY, N. Y.—Only one bid was received by the Board of Contract and Supply, Dec. 19, for lighting the streets of the city, which was submitted by the Municipal Gas Company for a term of five years. The bid was rejected immediately as the terms were considered too high. The company put in a bid of 26 cents per arc lamp per night and 5½ cents per night per incandescent lamp. Under the present contract the city pays 27 cents per night for each arc lamp, but has never used incandescent lamps for street lighting. New bids will be called for.

AUBURN, N. Y.—Plans are being considered by the State Water Board for conserving and developing the water-power of Owasco Lake. It is proposed to develop Owasco Lake as one of the reservoirs in the improvement of the water-power of the Oswego River basin. The work will be done entirely at the expense of the State. J. Walter Ackerman, of Auburn, is superintendent of the State Water Board.

BOLTON, N. Y.—The Bolton Light & Power Company has been granted permission by the Public Service Commission, Second District, to supply electricity in the town of Bolton, and also to issue $12,500 in capital stock and bonds to the amount of $10,000, the proceeds to be used for the construction and equipment of its plant.

BUFFALO, N. Y.—The Public Service Commission, Second District, has granted the Niagara & Erie Power Company permission to issue a mortgage on its property and franchises to the Guaranty Trust Company, of New York, N. Y., to secure the payment of bonds to the amount of $1,250,000. The company is authorized to issue presently $510,000, at not less than 85 and $100,000 in capital stock at par, the proceeds to be used for proposed improvements.

CATSKILL, N. Y.—Arrangements are being made for the consolidation of the Schoharie Light & Power Company, the Cairo Illuminating & Power Company and the Upper Hudson Electric Company in the near future. The companies have been controlled by the Stevens family, of Castle Point, Hoboken, N. J.

ELMIRA, N. Y.—The Elmira, Corning & Waverly Railway Company has been authorized by the Public Service Commission, Second District, to issue bonds to the amount of $689,000, the bonds to be delivered to the Southern Tier Development Company for the construction and equipment of an electric railway from Elmira to Corning, a distance of twelve miles.

FREDONIA, N. Y.—It is reported that the power house of the Buffalo & Lake Erie Traction Company, in Fredonia, N. Y., was damaged Dec. 16 by the explosion of two boilers, causing a loss of about $150,000.

HARTWICK, N. Y.—The Public Service Commission, Second District, has authorized the Hartwick Power Company to execute a mortgage to the Trust Company of America to secure an issue of bonds to the amount of $750,000. The company is permitted to issue presently $400,000 of these bonds and to issue $300,000 in capital stock. The proceeds to be used for the purchase of a hydroelectric development system on the Susquehanna River, at Colliers, Otsego County, and for general improvement purposes; also for the purchase of the steam electric power plant, formerly owned by the Otsego & Herkimer Railroad Company, located in Hartwick, N. Y., and for improvements made to the plant by the Trust Company of America, of New York, N. Y.

LYONS, N. Y.—Application has been made to the Public Service Commission, Second District, by the Wayne County Gas & Electric Company and the Geneva & Seneca Electric Company for permission to transfer their franchises, plants and systems to the Western New York Gas & Electric Company, which corporation is to be formed by the petitioners. Application will also be made for authority to the Western New York Gas & Electric Company to issue $450,000 in capital stock for exchange for the stock of the two petitioning companies; for authority to acquire all of the present capital stock of the two companies and for permission for the Western New York Gas & Electric Company to make a mortgage for $1,250,000, and to issue $800,000 in bonds to be secured by this mortgage. The company owns plants and franchises in Lyons, Clyde, Palmyra and Newark.

MIDDLEPORT, N. Y.—The Public Service Commission, Second District, has authorized the Middleport Electric Light & Gas Company to exercise its franchise granted by the town of Royalton to furnish electricity for lamps in that town.

NIAGARA FALLS, N. Y.—The Public Service Commission, Second District, has authorized the Niagara Falls Power Company to issue its capital stock to the amount of $1,534,000 per value, the proceeds to be used to take up its series of debentures.

ONEIDA, N. Y.—The Board of Public Works has adopted a resolution calling for a special meeting to be held Jan. 12, 1911, to consider the question of establishing a municipal electric light plant in Oneida.

OSWEGO, N. Y.—The City Council has authorized Mayor Fitzgibbons to engage a hydraulic engineer to examine plans for the new power house which is to be erected by the city. Plans were prepared under the supervision of Superintendent Ormsby, of the Water Department.

OWEGO, N. Y.—The Owego Light & Power Company has been authorized by the Public Service Commission, Second District, to issue $32,000 in capital stock, the proceeds to be used to pay outstanding indebtedness.

PATCHOGUE, N. Y.—The Patchogue Electric Light Company has received authority from the Public Service Commission, Second District, to issue $30,000 in additional capital stock, the proceeds to be used to extend its plant at Centre Moriches.

PHELPS, N. Y.—The Board of Village Trustees has asked for bids on four propositions to light the streets of the village of Phelps, under a five-year contract. Propositions one and two call for an all-night and 12 o'clock service by electricity, respectively, with forty-three arc lamps of 1600 cp. The third and fourth propositions are for a similar service, with gasoline substituted for electricity. Bids will be received by the trustees until Jan. 2.

ROCHESTER, N. Y.—The property of the Buffalo, Lockport & Rochester Railway Company has been purchased by Charles D. Beebee, president of the Rochester, Syracuse & Eastern Railway Company, and associates. The Beebee interests have now within their reach direct connection between Syracuse and Buffalo. The Buffalo, Lockport & Rochester Railway was an amalgamation of several small electric railways, and cost $6,000,000 to build.

UTICA, N. Y.—The Public Service Commission, Second District, has authorized the Utica Gas & Electric Company to issue $500,000 in bonds, to be sold at not less than 95, the proceeds to be used to discharge an indebtedness incurred for construction and extension of its plant.

WATERTOWN, N. Y.—The Public Service Commission, Second District, has authorized the Deer River Power Company to exercise the franchises granted in the towns of Denmark and Champion and the village of West Carthage to supply electricity in these places.

WHITE PLAINS, N. Y.—The Westchester Street Railroad Company, of White Plains, which operates an electric railway in Mt. Vernon, New Rochelle and White Plains, N. Y., with connecting interurban lines, is reported to have decided to erect a large power house in White Plains, at a cost of $200,000. It is also proposed to enlarge the car barns, improve and rebuild some of its lines.

CHARLOTTE, N. C.—Preparations are being made by the Barium Orphanage for the construction of an electric light plant, water and sewerage systems, at a cost of about $8,000. Rev. George Atkinson is chairman of committee.

NEWBERN, N. C.—Arrangements are being made by the Nuese-Trent Traction Company, of Newbern, N. C., for the construction of a railway four miles in length in this city for which contracts will soon be awarded. Electricity for operating the proposed railway will be supplied by the municipal electric plant. The company is capitalized at $200,000. A. E. Stevens, of Newbern, N. C., is president.

SPRAY, N. C.—The Spray Utilities & Terminal Company has awarded a contract for the construction of its proposed electric railway from Ridgeway, Va., to Spray, N. C., ten miles in length, to the Luck Construction Company. S. H. Marshall is interested in the project.

WINSTON-SALEM, N. C.—The new plant of the Inverness Mills Company, in Winston-Salem, will be completed early in January. The mill will be equipped with 8000 spindles, 200 40-in. automatic looms, etc., for manufacturing print cloths. The company is also building a substation, which is to be equipped to step down electricity from 10,000 volts to 2300 volts for distribution for lamps and motors. Energy for the plant will be supplied from the Winston-Salem transmission line of the Southern Power Company.

BUXTON, N. D.—The Red River Valley Telephone Company has increased its capital stock from $100,000 to $200,000, the proceeds to be used for extensions to its toll lines.

CARRINGTON, N. D.—The Western Electric Company has submitted a proposition to the City Council for lighting the streets of the city and for operating the pumping station of the city water works system. Under the plan submitted for street lighting it is proposed to replace the present arc lamp system for tungsten lamps. It is estimated that a saving of $50 per month can be effected if the city accepts the proposition of the corporation for pumping the city water. The company proposes to install a 20-hp electric motor at the pumping station to operate the pumps.

HETTINGER, N. D.—The erection of a farmers' telephone line south through Bison, S. D., and other towns in Perkins County is under consideration.

JACKSON, OHIO.—Contracts for new equipment for the municipal electric light plant have been awarded as follows: For engines to the Ball Engine Company; heaters and pumps to the Scioto Valley Supply Company, and to the Fort Wayne Electric Works for generator, switch-

board and street lighting outfit. The Capitol Engineering Company, 48-50 North Street, Columbus, Ohio, has charge of the engineering work.

PORTSMOUTH, OHIO.—The Portsmouth Street Railway & Light Company is planning to build an extension of its railway from Sciotoville and Hanging Rock, where it will connect with the Ohio Valley Electric Railway. It is expected that work will begin on the road next summer.

SIDNEY, OHIO.—Bids will be received by the Director of Public Service until Jan. 2, 1911, for lighting the streets of the city for a term of ten years. The contract will cover 110 arc lamps and from 50 to 75 incandescent street lamps. Edd McVay is Director of Public Works.

GUTHRIE, OKLA.—Sealed bids will be received by A. A. Leer, city clerk, until Jan. 5, for improvements to the municipal filtration plant, including one single-stage centrifugal pump direct-connected to electric motor, motor to be equipped with starting box, pump to supply 1400 gal. of water per minute; one pressure blower direct-connected to electric motor to be equipped with starting box, pressure blower to supply 900 cu. ft. of free air at a pressure of 5 lb. per square inch, both to be installed with necessary valves, fitting connections, switching, starting boxes, wiring and foundation. Also one complete air mainfold system for two filter beds, each filter 10 ft. x 18 ft. Electric current furnished by the city for operating motors is 220 volts, three-phase, 60-cycle, alternating current.

EUGENE, ORE.—H. M. Byllesby & Company, of Chicago, Ill., who purchased several plants in the Willamette Valley of the Northwestern Corporation last spring, have reorganized the properties under the name of the Oregon Power Company, and are planning extensive improvements, which will involve an expenditure of about $1,500,000. The electric plant in Eugene is to be more than doubled in size and other improvements made at a cost of about $350,000. Electricity generated at the Eugene plant will be transmitted to Junction City and Harrisburg and possibly Albany. The transmission line to Harrisburg, with the exception of the portion which will cross the McKenzie River, is already finished. Electrical service in Albany is now supplied from the Corvallis plant. The plans include the construction of a power plant on the McKenzie River, near St. Martins Rapids, at a cost of about $1,000,000, which will supply electricity for lamps and motors in towns and cities in the Willamette Valley as far north as Albany. The steam plant at Springfield will be used as an auxiliary after the new plant is in operation. As yet no steps have been taken in connection with construction of the proposed plant. All lighting and power contracts are now being taken under the name of the Oregon Power Company. The Northwestern Corporation, with head offices in Philadelphia, Pa., is still in existence.

GRANTS PASS, ORE.—Preparations are being made to enlarge the facilities of the Golden Drift dam irrigation project, next summer, which will involve an expenditure of about $40,000. The company will also spend a large sum for the development of electrical power.

KLAMATH FALLS, ORE.—A preliminary report has been filed with the Secretary of the Interior relative to the proposed hydroelectric power development and roads in Crater Lake National Park. The water for the proposed development will be taken from Anna Creek, about five miles from the camp at Crater Lake.

ONTARIO, ORE.—The Telluride Power Association is reported to have awarded the contract for the construction of an electric power plant at the confluence of the Malad and Snake Rivers in Idaho. The plant will have an output of about 10,000 hp and will supply electricity for municipal and irrigation purposes. The cost of the plant is estimated at about $2,000,000. A transmission line will extend from the power plant to Payette, passing through Glenns Ferry, Mountainhome, Boise and other towns in that vicinity.

PORTLAND, ORE.—The Mount Hood Railway Company has applied for a franchise to construct and operate an electric railway throughout the city. R. C. Gillis, of Los Angeles, Cal., is chairman of board of directors. C. B. Smith is local manager.

PORTLAND, ORE.—The Mt. Hood Railway & Power Company has purchased a site on the Willamette River from the Peninsular Lumber Company for its first auxiliary steam power plant. The contract for construction of the plant has been awarded to Charles E. Moore & Company, of San Francisco, Cal.

REDMOND, ORE.—The Crook County Water, Light & Power Company, of Redmond, Ore., is reported to be contemplating the construction of an electric railway from Redmond to Prineville. The company is now constructing a hydroelectric power plant at Cline Falls, on Deschutes River, about four miles from Redmond.

BROOKVILLE, PA.—Preparations are being made by the Brookville Water Company, of Brookville, Pa., for enlarging and improving its system. New equipment will be purchased, including pumping units and electrical machinery, compressor, etc. The plant will be driven by gas engines. Contracts for outside work have already been awarded.

DARBY, PA.—The Griswold Worsted Company, of Darby, Pa., has awarded contract for the erection of the addition to its power house in this city, work on which will begin at once. It is understood that contracts for equipment for the plant have not yet been placed. A. Holcroyd, of Darby, Pa., is purchasing agent for the company.

DUNCANNON, PA.—The Duncannon Iron Works Company is installing an electric plant to provide electricity for lamps and motors for its works. The municipal electric plant has supplied the service for a number of years.

PITTSBURGH, PA.—Plans are being made by W. L. Curry for remodeling the building, formerly used by Baur Brothers for a bakery, on Kirkwood Street, between Euclid Avenue and St. Clair Street, for light manufacturing and power plant. The plans call for a fireproof building and the installation of elevators.

PITTSBURGH, PA.—In the bid submitted to the Common Council by the Allegheny County Light Company for lighting the streets and public buildings for the year 1911, the price for arc lamps furnished on overhead circuits was reduced from $72 to $70 each per year. The price for arc lamps supplied by the underground circuits will be $90 per lamp per year, for 100-watt tungsten lamps $25 each per year, and for 250-watt lamps $40 each per year, which is the same as the present contract.

SHARTLESVILLE, PA.—The Shartlesville Rural Telephone Company is planning to extend its telephone lines to Centreport and Scull Hill.

YORK, PA.—It is reported that the Tennis Company, Magee Building, Pittsburgh, Pa., is preparing plans for the construction of the proposed electric railway of the York & Glen Rock Railway Company, which is to extend from York to Loganville.

CHESTER, S. C.—The equipment of the Springstein Mills is being changed to manufacture a much finer grade of ginghams. The mills are equipped for electrical operation. Leroy Stevens is manager.

ETOWAH, TENN.—Application has been made to the Council by T. F. Peck and others for a franchise to install an electric light, ice plant and water works system in Etowah.

MANCHESTER, TENN.—The City Council is considering the question of issuing bonds for the construction of a municipal electric light plant.

PARKSVILLE, TENN.—The contract has been awarded by the Eastern Tennessee Power Company for electrical equipment for its power plant at Parksville, Tenn., to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. The contract for four water-wheels having a rating of 5400 hp each was awarded to S. Morgan Smith Company, of York, Pa. M. S. Hopkins is vice-president of the company.

SHELBYVILLE, TENN.—Plans are being considered by W. J. McGill and associates for the erection of a cotton mill in Shelbyville. It is proposed to purchase cotton yarns and weave cloth. Only looms and power machinery will be required. The plant will be operated by electricity.

NACOGDOCHES, TEX.—The City Council has authorized its secretary to secure the cost of erecting an electric light plant, to be owned by the municipality. When the information is obtained the proposition to issue bonds for installation of same will be submitted to a vote of the people. The local company has recently installed meters and discarded flat rates. The minimum charge on a basis of ten lamps is $2; 20 cents per kw-hour for the first 8 kw, 15 cents for the second 8 kw, 10 cents for the third 8 kw, and 5 cents per kw-hour for all above, with a rate of 25 cents per month for meter. If the meter is purchased by the owner of a building, the price is $10.25 for each meter.

PORT ARTHUR, TEX.—It is reported that the Port Arthur Water Company is contemplating increasing the output of its electric light plant.

WACO, TEX.—It is reported that the proposition to issue $250,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant, will be submitted to a vote. P. A. Gorman is city commissioner.

BRATTLEBORO, VT.—At a special town meeting held recently the citizens voted to authorize the Board of Bailiffs to enter into a contract with the Twin State Gas & Electric Company for a term of one year for street lighting. Under the terms of the contract the company is to furnish arc lamps at $70 each per year and incandescent lamps at $17 per lamp per year, with an all-night service. The company has refused to furnish street lamps at the above rates for one year, which were submitted on a basis of a five-year contract. On a one-year contract the company offers to supply arc lamps at the rate of $80 each per year, and 40-cp incandescent lamps at $20 per lamp per year.

IVANHOE, VA.—The Carter Iron Company, Farmers' Bank Building, Pittsburgh, Pa., is reported to be contemplating the construction of a hydroelectric power plant, near its furnace property. It is understood that investigations have been made and report submitted by Lenz & Mole, engineers, 71 Broadway, New York, N. Y.

LEXINGTON, VA.—A consolidation of the Lexington Light & Power Company and the Rockbridge Power Corporation is reported to be under consideration for the purpose of supplying the city with electricity for lamps and motors.

MARTINSVILLE, VA.—At an election held Dec. 8 the citizens voted to issue $35,000 in bonds, the proceeds to be used for improvements to municipal electric light plant and water works system.

SMITHFIELD, VA.—The proposition to issue $55,000 in bonds, the proceeds to be used for the installation of an electric lighting system and sewerage system, will be submitted to a vote at an election to be held Feb. 21.

BISMARCK, WASH.—A bonus of $20,000 has been subscribed by the residents of Bismarck as an inducement to the Tacoma Railway & Power Company to extend its McKinley Park line to the city limits at South Sixty-fourth Street.

CHEHALIS, WASH.—The directors of the Twin City Light & Traction Company have authorized an expenditure of $100,000 for improve-

ments to its system, including the construction of a power house to be equipped with new machinery. E. Storer Tice is local manager.

COLVILLE, WASH.—The County Commissioners have granted a franchise to Louis P. Larson to construct and operate a water works system in Metaline Falls; also to install and operate an electric light and telephone system.

KENNEWICK, WASH.—The Pacific Power & Light Company, of Portland, Ore., has awarded a contract for poles for the proposed high-tension transmission line from Kennewick to Hanford, Wash., to the R. E. Downie Pole Company, of Seattle, Wash.

MARCUS, WASH.—It is reported that H. V. Gates, of Hillsboro, Ore., and H. R. Williams, of Colville, Wash., have submitted a proposition to the Commercial Club for the installation of an electric light and power plant in Marcus.

RICHLAND, WASH.—Negotiations are under way between the Lower Yakima Irrigation Company and the Pacific Light & Power Company, of North Yakima, Wash., for the erection of a tranmission line to connect with the high-tension lines of the Pacific company to supply electricity to operate the two pumping stations of the irrigation company.

SUMNER, WASH.—Board of County Commissioners has granted the Equality Telephone Company a franchise to erect telephone lines along the county road to Dieringer.

MORGANTOWN, W. VA.—It is reported that plans are being considered by the Morgantown & Dunkard Valley Railroad Company for the construction of a new power house in Morgantown.

ASHLAND, WIS.—Arrangements are being made by E. A. Appleyard, of the Ashland Lighting Company, to begin work on the construction of a power dam on the Bad River, near Mellan, in the near future.

BLOOMER, WIS.—The State Railroad Commission has withheld its decision in regard to the application of the Bloomer Electric Light Company for permission to increase its rates for electrical service. After making an inspection of the plant the commission finds that it is impossible for the company to furnish adequate service with the present equipment. Two propositions were submitted to the company for improving and increasing its service: One was to repair and change the present water-power equipment and to install a gasoline engine, for auxiliary purposes, and the other to purchase energy from the Chippewa Valley Railway, Light & Power Company at its switchboard at Chippewa Falls. The second proposition would necessitate the abandonment of the existing generating station and the construction of an eight-mile transmission line from the present plant to Chippewa Falls. The commission advises the company that it must take immediate steps to bring its service conditions up to the standard required in the State.

ENDEAVOR, WIS.—It is understood that the proposed plant of the Endeavor Electric Light & Power Company will be located in Valders, Wis. The headquarters of the company are at Endeavor.

HATFIELD, WIS.—The report that the La Crosse Water Power Company is to sell its dam and power plant in Hatfield to the Minneapolis, St. Paul, Rochester & Dubuque Traction Company is denied by the officials of both companies. M. W. Savage, president of the traction company, states that the company will build its own plant.

KAUKAUNA, WIS.—As a special election held recently the citizens voted to purchase the plant and holdings of the Kaukauna Electric Light Company. Owing to the city and the company being unable to come to an agreement in regard to requiring the company to improve its service, an appeal was made to the Wisconsin Rate Commission. In the decision handed down the commission favored the city in practically every point. The commission will be asked to appraise the property and set a purchase price.

MADISON, WIS.—J. E. Jones, secretary of the Chicago & Wisconsin Valley Street Railways Company, states that work on construction of its proposed railway will begin in April, 1911, between Madison and Portage. The company has taken offices in the Washington Building, Madison, Wis.

MARINETTE, WIS.—Local business men are considering the question of developing additional power on the Menominee River.

MENASHA, WIS.—The Lakeside Paper Company, recently organized, is planning to erect a large paper mill in Menasha, Wis., to include a steam and electric power plant. The plant will be equipped for electric motor drive. E. J. Lachman, of Neenah, Wis., and others are interested in the project.

MILWAUKEE, WIS.—The Continental Realty Company is reported to be contemplating the erection of three substations, equipped with transformers. The company operates a large electric power plant in Milwaukee.

PRAIRIE DU SAC, WIS.—Surveys are being made by the Wisconsin River Power Company for its proposed dam to be erected across the Wisconsin River, near Prairie du Sac. According to the present plans the dam will be 1500 ft. long with 1000 ft. spillway, with a head of 25 ft., capable of developing 26,000 hp. Transmission lines will be erected to Milwaukee and Madison and also to North Freedom to supply electricity for the mines in that section. R. G. Walter has charge of the work.

STOUGHTON, WIS.—The City Council has adopted a resolution favoring the purchase of the property of the Stoughton Mill Company, at a cost of $18,700. It is proposed to utilize the power for both the electric light plant and water works system.

VANCOUVER, B. C., CAN.—Plans are being considered for financing a scheme for improvements on Grouse Mountain, which include the construction of several miles of electric railway, costing $38,000 per mile, on the slope of the mountain. It is understood that a charter has been obtained and work will begin in the spring. C. S. Gzowski, C. H. Allen, Walter Gravely and others are interested in the project.

VICTORIA, B. C., CAN.—It is reported that the city purchasing agent will soon call for proposals for 2000 lb. of copper wire for the municipal lighting department.

HAMILTON, ONT., CAN.—Orders have been placed by the Dominion Power & Transmission Company with the Canadian Westinghouse Company, of Hamilton, Ont., for an 8500-kw generator to be installed in its Decew Falls plant, at a cost of about $200,000. The company is also planning to erect another substation in Hamilton, to be completed by next June.

LONDON, ONT., CAN.—Adam Beck, chairman of the Hydro-Electric Power Commission, has announced the government's plan for supplying electricity for farmers. Low-tension wires are to be erected to radiate thirty miles from the power centers. The government proposes to adopt the same principle as the municipal telephone system, under which twenty farmers could go to the County Council and have a telephone line erected, paying for it on the same basis as a local improvement. It is proposed to have the government erect the lines, which the consumers would pay for at the rate of 4 per cent on the investment, retiring the indebtedness at the end of fifteen or twenty years.

TORONTO, ONT., CAN.—The towns of Midland and Penetanguishene have applied to the Hydro-Electric Power Commission for energy. The commission has already made arrangements to meet the requirements of the Georgian Bay towns, provided the ratepayers vote in favor of the project. Arrangements have been made with the Simcoe Power Company, which owns a large plant at Big Chute, on the Severn River, capable of developing 4000 hp. The company's transmission lines already extend to Midland, and if the towns decide to make a contract with the commission the line would be extended from Midland to Penetanguishene. The two towns will require 1500 hp. The price has not yet been decided upon.

New Industrial Companies.

THE BAYONNE CONSTRUCTION COMPANY, of Bayonne, N. J., has filed articles of incorporation with a capital stock of $50,000 for the purpose of doing a general construction and engineering business. The incorporators are: S. Horwitz, N. Lazarus and others, of Bayonne, N. J.

THE BETTES ELECTRO-CHEMICAL COMPANY, of Kansas City, Mo., has been incorporated, with a capital stock of $50,000, by Ambro Bettes, Francis E. S. Stoddard and others.

THE B. & L. COMPANY, of Norwich, Conn., has been incorporated with a capital stock of $50,000 for the purpose of manufacturing all styles of ball bearings products, which have previously been imported from Germany. Otto Bruenauer is president of the company and B. F. Leavitt treasurer. The New York office is at 50 Church Street.

THE CORPORATION SERVICE COMPANY, of Rochester, N. Y., has been incorporated by Gilbert MacPherson, Roy E. Bowen and Edward J. Meyer, all of Rochester, N. Y. The company proposes to do electrical work of all kinds.

THE DELTA ELECTRO-PLATING & MANUFACTURING COMPANY has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $25,000. The incorporators are: J. C. Huss, of Wissahicken, Pa.; S. Zeidman, of Philadelphia, Pa., and J. S. Collins, Jr., of Dover, Del.

THE DUPLEXO VACUUM CLEANER COMPANY, of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $50,000 to manufacture vacuum cleaners, etc. The incorporators are: Adolph Klindtworth, 363 East Thirty-second Street; Hugo Goldenberg, 110 West Twenty-ninth Street, both of New York, N. Y., and Max French, 842 Madison Street, Brooklyn, N. Y.

THE FLOWER STEEL & ELECTROTYPE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $50,000, by Edwin Flower, 313 Gregory Avenue, Passaic, N. J.; William Hill, 27 William Street, New York, N. Y.; Victor Nivols, 338 First Street, Brooklyn, N. Y.

THE LORAINE DEVELOPMENT COMPANY, of Albany, N. Y., has been granted a charter with a capital stock of $60,000 for the purpose of manufacturing machinery, mechanical apparatus, etc. The incorporators are: C. M. Sand, S. A. Murphy, of Albany, N. Y., and W. Hurst, Jr., of Hurstville, N. Y.

THE MARSH VALVE COMPANY, of Dunkirk, N. Y., has been incorporated with a capital stock of $250,000 to manufacture valves of all kinds. The incorporators are: W. C. Marsh, N. F. Gould and W. J. Reed, of New York, N. Y.

THE NATIONAL AUTOMATIC ROLL ADVERTISING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $200,000, by S. A. Diamond, of Borough of the Bronx; P. A. Diamond and I. Alvia, of New York, N. Y. The company proposes to manufacture advertising devices, etc.

THE NEW ENGLAND AUTOMATIC WATER POWER COMPANY,

of York, Maine, has been granted a charter with a capital stock of $1,000,000 for the purpose of dealing in mills, machinery, etc. U. S. Jackson, of Ossipee, Maine, is president, and S. B. Smith, of Berwick, Maine, treasurer.

THE RELIABLE ARC LAMP COMPANY, of New York, N. Y., has been chartered with a capital stock of $15,000 for the purpose of manufacturing electric light fixtures, etc. The incorporators are: Joseph Boderman, 18 Amboy Street; Joseph Miller, 418 Barbey Street; Nathan Greenberg, 51 Christopher Avenue, all of Brooklyn, N. Y.

THE ROJAS ELECTRO-CHEMICAL COMPANY, of New York, N. Y., has been chartered, with a capital stock of $50,000, by George F. Schoonmaker, Ralph B. Schoonmaker, 14 Maiden Lane; Carl S. Brown, 38 Park Row, all of New York, N. Y. The company proposes to do electroplating, etc.

THE STERN MOTOR COMPANY, of New York, N. Y., has been incorporated by Frank M. Randall, 125 East Forty-seventh Street; Philip K. Stern, 520 West 183d Street; L. Rosenberg, 604 West 162d Street, all of New York, N. Y. The company is capitalized at $100,000 and proposes to manufacture motors, engines, vehicles, machinery, etc.

THE SUFFOLK CONTRACTING COMPANY, of Huntington, N. Y., has been chartered with a capital stock of $20,000 for the purpose of doing a general contracting and engineering business. The incorporators are: John McBrien, Daniel E. Lynch and Marion L. Dawson, all of Huntington, N. Y.

THE UNITED STATES SIGNAL COMPANY, of Pittsburgh, Pa., has been organized for the purpose of establishing a factory for the manufacture of boxes and other apparatus for police and fire alarm systems. Thomas A. McQuaide and others are interested in the project.

THE ZUNNER MACHINES COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $25,000 to manufacture boilers, machinery, hardware, etc. The incorporators are: John H. G. Zunner, William D. Clapp and Hugh Satterlee, all of Rochester, N. Y.

New Incorporations.

DELIGHT, ARK.—The Delight Telephone Company has been chartered with a capital stock of $1,000 by G. M. Parsons, R. W. Stroll and others.

KERMAN, CAL.—The Kerman Telephone Company has filed articles of incorporation with a capital stock of $15,000.

MIDDLETOWN, CONN.—The Middlesex Light & Power Company has been organized by Major T. M. Russell, G. B. Carlson, William L. Whitney, of Middletown, Conn.; Niles E. Gladding, of Essex, Conn., and Ernest L. Pratt, of Saybrook, Conn. The company has applied to the General Assembly for a charter and proposes to do business in Essex, Saybrook, Chester, Haddam, East Haddam, Old Saybrook, Westbrook, Clinton, Madison, Old Lyme and Killingworth.

BLOOMINGTON, ILL.—Articles of incorporation have been filed for the Bloomington, Decatur & Champaign Electric Railway Company by B. E. Bramble, W. H. Carnahan, George R. McComb, L. Campbell and E. S. Cole, all of Champaign, Ill. The company is capitalized at $3,525,000 and proposes to construct and operate an electric railway from Bloomington to Champaign, via Decatur.

ALLERTON, IA.—The Allerton Telephone Company has been incorporated, with a capital stock of $10,000, by W. T. Grimes, R. Z. McCoy, B. Bracewell and others.

ELKADER, IA.—The Boardman-Wagner Telephone Company has been incorporated, with a capital stock of $1,600, by Armund Larson, Jacob Eggiman, William Huebner, Henry Korsch and others.

KEOKUK, IA.—The Mississippi River Power Company has been chartered with a capital stock of $500,000 to construct a hydroelectric power plant. It is understood that the Stone & Webster Engineering Corporation, of Boston, Mass., is interested in the project. For further information, address Jeremiah Smith, Jr., 84 State Street, Boston, Mass.

WAVERLY, IA.—The Washington Rural Telephone Company has been incorporated by H. O. Steege, John J. Becker, Herman Brandt, W. C. Steege, F. H. Meyer and A. F. Sauerbrei. The company is capitalized at $6,000.

EVARTS, KY.—The Martin's Fork Telephone Company has been organized by C. Haynes and others. The company is capitalized at $2,000 and proposes to install a telephone system in Evarts with extensions from Evarts to Jonesborough and Poor Fork.

BOSTON, MASS.—The Boston & Suburban Electric Transportation Company has been incorporated with a capital stock of $110,000 for the purpose of doing a general transportation business. The officers are: F. D. Stranahan, of Wellesley Hills, president, and W. E. Eldridge, of Salem, Mass., treasurer.

SEDALIA, MO.—The Hughesville & Sedalia Trunk Line Telephone Company has been granted a charter. The incorporators are G. W. Lanes, L. H. Durley, S. E. Harvey and others.

WELLSVILLE, MO.—Articles of incorporation have been filed for the Wellsville Light, Power & Water Company by C. H. Early, J. T. Mitchell, E. R. Barrett and others. The company is capitalized at $15,000.

PHILLIPSBURG, MONT.—Articles of incorporation have been filed for the Flint Valley Telephone Company with a capital stock of $5,000 for the purpose of erecting telephone lines in the valley south of Phillipsburg, and on the upper and lower Rock Creek. Connection with long-distance lines will be made at Phillipsburg. Mrs. E. L. Walker is president and general manager.

JERSEY CITY, N. J.—Articles of incorporation have been filed for the North Carolina Electric & Power Company, with a capital stock of $120,000, by L. H. Sanders. W. P. Riley, of New York, N. Y., and J. R. Turner, of Basking Ridge.

YADKINVILLE, N. C.—The Yadkinville Telephone Company has been incorporated with a capital stock of $6,000 to construct and operate a telephone system. W. L. Hudspeth and others are the incorporators.

Personal.

DR. ALEXANDER GRAHAM BELL has been elected an honorary member of the Royal Institute, London.

MR. EDWARD N. EGGE, formerly of Sheffield, Ia., has been appointed assistant manager of the Home Telephone Company, at Oxnard, Cal.

MR. JOHN M. HANCOCK, a former Mayor of Niagara Falls, N. Y., has been appointed industrial agent of the Cliff Electrical Development Company at Niagara Falls.

MR. BION J. ARNOLD has been elected a director of the Chicago Association of Commerce, succeeding Mr. John M. Roach, of the Chicago Railways Company, resigned.

MR. A. N. BENTLEY, Atlanta representative of the Electric Storage Battery Company, delivered a lecture on "Automobile Batteries" at the Carnegie Library, Atlanta, Ga., on Dec. 14.

MR. CLARK F. ROSS, who has been associated with the Commonwealth Edison Company, of Chicago, for the last three years, has been appointed advertising manager of the Pelouze Electric Heater Company, of that city.

MR. C. L. MORGAN has resigned from the General Electric Vehicle Company to accept the position of advertising and publicity manager with the Lansden Electric Vehicle Company, now allied with the Edison Storage Battery Company.

MR. WILLIAM DARBEE, who has been assistant general manager of the Consolidated Gas, Electric Light & Power Company, of Baltimore, for the past eight years, has resigned to assume charge of the electric plant of the Brooklyn *Daily Times*.

MR. LEROY B. CRAMER, electrical engineer of the Oregon Electric Railway Company, has been appointed electrical engineer of the United Railways Company, Portland, Ore. Mr. Cramer is chairman of the Portland section of the American Institute of Electrical Engineers.

MR. J. E. ALDRED, president of the Pennsylvania Water & Power Company, which has taken over the McCall Ferry Power Company, has been elected president of the Consolidated Gas, Electric Light & Power Company, of Baltimore, to succeed ex-Mayor F. C. Latrobe. Mr. Latrobe will remain a director and will act as special counsel for the company.

MR. F. M. SINSABAUGH, who was manager of the Carrollton (Ill.) Heat, Light & Power Company for fourteen years, has resigned his position to accept the management of the Citizens' Gas, Electric & Heating Company at Mount Vernon, Ill. He will also have the management of the Indiana Water & Light Company at Worthington, Ind., and of the St. Anne Light & Water Company, at St. Anne, Ill.

MR. THOMAS E. MITTEN, president of the Chicago City Railway Company and vice-president of the International Railway Company, of Buffalo, has undertaken the general supervision of the rehabilitation of the property and service of the Philadelphia Rapid Transit Company under a five-year contract. It is said that $10,000,000 is to be expended in betterments and $1,500,000 for repairs and renewals of the Philadelphia street railway system. Mr. Mitten will retain his Chicago position.

MR. EDWARD W. LEANING, of Albany, N. Y., has been appointed by the Public Service Commission, Second District of New York State, assistant chief of the division of statistics and accounts. Mr. Leaning has been for thirty years an employee of the Delaware & Hudson Company, occupying various clerical positions from minor clerk to an executive position as chief clerk in the office of the auditor of disbursements of that company. Mr. Leaning was one of the successful candidates at a recent examination held by the Civil Service Commission. The salary of the position is $2,400 per annum.

Obituary.

W. J. WHETZEL, proprietor and manager of the Eureka Electric Service Company, Eureka, Ill., met death in a violent form at 11 a. m., Nov. 26, when his arm became caught on the shaft of his 100-hp high-speed engine, tearing the limb from its socket and inflicting other severe wounds on his head and body. He was attempting to adjust a small belt on the engine shaft for driving a drill press when in some way the belt became entangled, throwing him onto the shaft. He is survived by a widow and by four young sons, two of whom witnessed the accident. Mr. Whetzel was forty years of age, and was prominent in a business and educational way in the county in which he lived. He organized the

Eureka company and built the electric plant six years ago. The property passes to his widow, Mrs. Mary J. Whetzel.

MR. SAMUEL S. DICKENSON, general superintendent and vice-president of the Commercial Cable Company, died at his home in New York City on Dec. 23. Mr. Dickenson was born in Plymouth, England, in 1859. In 1874 he helped to establish the Torbay station of the Direct United States Cable Company. In 1884 he joined the Commercial Cable Company, and established its station at Hazelhill, Canso, Nova Scotia. In 1900 he established the Commercial Cable station at Fayal, Azores, and opened up the first cable communication between Portugal, the Azores Islands and North America. For his services in this connection he was decorated by King Carlos. In 1901 he selected the landing places for the Commercial Pacific Cables in Honolulu, Midway, Guam and Manila. Mr. Dickenson became a full member of the American Institute of Electrical Engineers in 1889. He was also a member of the (British) Institution of Electrical Engineers.

Trade Publications.

THREE-WIRE GENERATORS.—The Triumph Electric Company, of Cincinnati, Ohio, has issued Bulletin No. 441 describing its line of three-wire generators, ranging in rating from 25 kw up. Three collector rings are mounted on the generator shaft and the armature is tapped at the proper points and connected to these rings. Three balancing coils in a transformer are supplied with energy from these rings and the coils are interconnected, the middle point forming the neutral wire of the three-wire system.

MAGNETO.—Bulletin No. 25, issued by the Connecticut Telephone & Electric Company, of Meriden, Conn., is devoted to a description of the company's new magneto, intended for automobile use. The magneto has a single primary winding running to a switch and all the secondary wires connect from the magneto to the spark plug. The transformer coil, as part of the outfit, is incased in a metal tube threaded into the magneto in cartridge form. Two types are manufactured, one independent and the other for use in conjunction with a battery.

SOLDERLESS CONNECTORS.—In tapping or connecting large cables the use of solderless connectors expedites the work considerably. Connectors of this kind may also be used on all classes of wiring and are approved by the underwriters. Dossert & Company, of New York, have issued Catalog No. 5, illustrating and describing the entire line of solderless connectors manufactured by the company for solid and stranded wires. These include taps, elbows, front-connected lugs, three-way and two-way connectors, equalizers, grounding devices, terminals, etc.

AUTOMATIC ELECTRIC LIGHTING SYSTEM FOR AUTOMOBILES.—The advantages of electricity for lighting automobiles are now generally appreciated by car owners and there are a number of systems on the market, which, in addition to furnishing all the light necessary, supply ample energy for ignition purposes. The Hartman generator system, which is described in a bulletin issued by the Hartman Electrical Manufacturing Company, of Mansfield, Ohio, consists of a low-voltage generator driven from the engine shaft, a battery floating on the line and a regulator operating to maintain constant voltage. Included in the latter is an automatic switch to connect the generator to the battery circuit when the engine reaches a certain speed. The system is wholly automatic and requires no attention other than oiling the bearings. The company also handles the necessary accessories.

BUSINESS NOTES.

CENTURY MOTORS.—The Century Electric Company, St. Louis, reports that the demand for "Century" single-phase motors increased during the year 1910 over 1909 almost 100 per cent. While energetic effort has been made to create this demand, the great increase indicates the growth of favor for the motor driver, and especially for the single-phase motor of the repulsion-induction type. Provision is being made for a corresponding increase in business next year, as the business situation appears to warrant it.

THE MOORE LIGHT COMPANY has recently opened new sales offices and a demonstration room at 500 Fifth Avenue, New York City, where the various forms of the Moore light are on exhibition. The soft white light is artistically installed, showing its correct illuminating value for drawing rooms, art galleries, etc. The yellow light, placed around the picture molding, shows its adaptability for the general illumination of ballrooms, theaters, factories and large halls. The Moore "window," which is factory-made, is especially adapted for furnishing white light where color values are important, as in department stores, picture galleries, matching rooms, etc.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 19, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

978,828. ELECTRIC ILLUMINATING SIGN; W. W. Arnold, Hamilton, Ohio. App. filed Aug. 10, 1909. Produces illuminated figures for words or symbols through selecting mechanism controlled by a keyboard.

978,841. COMBINED ELECTRIC CONNECTION PLUG AND SOCKET AND SWITCH; W. W. Buckton, London, England. App. filed June 1, 1908. The socket may be rotated when the plug is inserted to operate the switch to open or close the circuit, and the plug cannot be withdrawn until the current has been switched off nor inserted until the switch is in the off position.

978,849. CIRCUIT CLOSER; H. B. Collier, Prairie Grove, Ark. App. filed Sept. 15, 1909. For doors and the like. A casing contains the circuit closer and a hinge which carries a number to actuate the circuit closer.

978,864. HARMONIC PARTY LINE TELEPHONE RINGER; C. J. Erickson, Chicago, Ill. App. filed Aug. 11, 1906. A tuned ringer so that alternating currents of different frequency may be employed for selectively ringing.

978,879. ELECTRIC CIRCUIT CHANGING MECHANISM; F. B. Hall, Wheeling, W. Va. App. filed June 30, 1909. A lock switch operated by a key, for automobiles and the like, the actuation of the lock operating the switch.

978,882. CIRCUIT BREAKER; F. W. Harris, Wilkinsburg, Pa. App. filed Dec. 14, 1908. A heavy current switch with copper and carbon contacts for switchboards with an operating crankshaft and links between the movable member and the shaft, the links extending through an aperture in the base.

978,888. APPARATUS FOR CARRYING OUT THE ELECTROLYTIC PRODUCTION OF SODIUM; P. L. Hulin, Grenoble, France. App. filed April 4, 1910. A circular anode formed by two electrically connected concentric cylinders and a cathode between them.

978,909. COMPOSITE TELEPHONE AND TELEGRAPH SYSTEM; O. M. Leich, Genoa, Ill. App. filed June 19, 1908. Includes telegraph receivers with keys for operating them and telephones connected to the line circuit, a back contact for each key and an impedance coil bridged around the back contact to decrease the telegraph disturbance on the telephone talking circuit.

978,933. SNAP SWITCH HANDLE ATTACHMENT; J. G. Peterson, Hartford, Conn. App. filed Sept. 3, 1910. Handle attachment for rotary snap switch, a washer with spring fingers rotating with the handle and having ratchet teeth held from rotation by the cap.

978,934. PROCESS FOR CONTINUOUS ELECTROLYSIS OF AQUEOUS SOLUTIONS; A. Pietzsch, Triberg, Germany. App. filed Nov. 17, 1909. For electrolyzing salt solutions to avoid the losses due to the products forming at the electrodes conducting the current by causing the electrolyte to flow through an anode chamber past an anode, in through a cathode chamber past a cathode and to pass through a supply of solid salt which is redissolved, and resupplied.

978,941. COMBINED CLEAT AND ROSETTE; F. Schimpf, St. Louis, Mo. App. filed June 24, 1910. A combined cleat and rosette having an inner section and an outer section to be secured together, which receive the line wires and having an extra portion for receiving the light wires.

978,951. PARTY LINE TELEPHONE; C. A. Soans and A. H. Graves, Chicago, Ill. App. filed May 4, 1907. Lock-out telephone system with a station selecting relay, an associate local circuit controlling relay, a local battery circuit, contacts operable by said latter relay for partially completing the local battery circuit and other contacts operated manually for completing the establishment of the local circuit.

978,953. TROLLEY RETRACTOR; L. B. Stanley, Collinwood, Ohio. App. filed March 19, 1909. A trolley support with a trolley pole swiveled thereto and toggle links fitted to the pole and a fixed part with a spring bearing against the joint of the toggle to force the wheel against the wire in one position of the toggle and to drop the wheel in another position.

978,958. TELEPHONE DESK SET APPARATUS AND CIRCUIT; B. W. Sweet, Cleveland, Ohio. App. filed April 27, 1906. A tubular standard with telephone transmitter and hook and switch actuated thereby and an inductive coil electrically connected with the receiver and within the standard and a removable base on which the standard is mounted.

978,959. LIGHTNING ARRESTER; P. H. Thomas, Montclair, N. J. App. filed June 7, 1905. A vapor device in connection with an air gap as a lightning arrester and vaporizable electrodes therefor and a starting band co-operating with said electrodes with means for abruptly applying the discharge to a starting band.

978,978. CONNECTION FOR STORAGE BATTERIES AND THE LIKE; L. H. Wirne, Philadelphia, Pa. App. filed Dec. 15, 1906. A flexible connection which may be bent repeatedly, including a lug connected to the plate, which lug surrounds the conductor and has a curved lip to permit bending without abrading the cover of the conductor, and a viscous packing between the cover and the lug.

978,980. FLUSH CURLING IRON HEATER; J. I. Ayer, Cambridge, Mass., and H. B. Gale, Natick, Mass. App. filed June 3, 1910. A curling iron heater in the form of a wall pocket with flush face. Details.

978,983. HIGH AND LOW WATER ALARM; C. Brent, Brandon, Manitoba, Canada. App. filed Jan. 2, 1907. Alarm for steam boilers in which the bypass or water gage is surrounded at two points with thermostats to close the circuit when the water level reaches the two points.

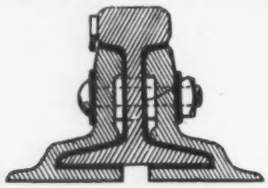
978,992. ELECTROMAGNET; B. G. Dunham, Rochester, N. Y. App. filed June 4, 1906. For electric relays in telephone systems, having pole pieces in the ends of the core, one of the pole pieces offset with an armature resting in the offset and extending beneath the end of the other pole piece.

978,999. RELAY; H. Gernsback, New York, N. Y. App filed March 14, 1910. For wireless work, a base carrying a standard on which a horizontal leaf spring is attached, and adjusting screw bearing on the spring, the end of the spring carrying an armature adjacent to the vertical core of the electromagnet.

979,011. SWITCH BOX STRUCTURE; A. D. Levy, Cleveland, Ohio. App. filed April 22, 1910. A gang of switch boxes which may be locked by keyhole-shaped openings and pins.

979,012. TELEPHONE REPEATER; C. D. Lindridge, Providence, R. I. App. filed Feb. 10, 1910. A source of unidirectional current and a negative resistance in a repeater circuit with lines for the voice currents and outgoing lines for the amplified currents and a non-inductive resistance which may be substituted in the circuit for the negative resistance.

979,015. RAIL-JOINT; L. P. Locke, Victor, N. Y. App. filed May 24, 1909. For railway signaling systems in which abutting rails are insulated from each other, a fishplate is secured to the rails and insulated therefrom and two bonds connect the rails with the plate on opposite sides of the joint.



979,015.—Rail-Joint.

979,050. ELECTRIC SWITCH; J. A. Ward, Spokane, Wash. App. filed Aug. 21, 1909. A compact switch with special form of handle, and special base to receive the handle with the parts inclosed to prevent short-circuiting if the switch is accidentally opened.

979,064. ELECTRICAL ELEMENTS; A. T. Konstantin Estelle and K. W. Henrik Evers, Fliseryd, Sweden. App. filed May 12, 1909. A mixture of metallic iron and metallic cadmium finely divided, mixed in a certain proportion to avoid the formation of ferric compounds for use with negative electrodes of batteries with alkaline electrolyte.

979,060. SINUSOIDAL WAVE-CURRENT APPARATUS; F. Cedergren, Hammond, Ind. App. filed Oct. 7, 1907. For electrotherapeutic work, a disk with an annular conductor or strip of resistance material with a pair of brushes on the opposite points of the disk and means for rotating the disk and brushes relative to each other, and a switch to connect the electrodes for the patient either in shunt or in series with the strip.

979,078. ELECTRIC MOTOR CONTROL; H. W. Leonard, Bronxville, N. Y. App. filed April 24, 1903. Four dynamos with separately excited fields and electric motor connected therewith and means for connecting the armatures to the four dynamos in multiple series and in series with each other for varying the speed and torque of the electric motor.

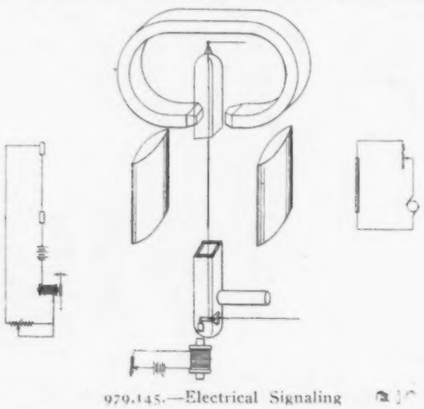
979,081. SIGNALING SYSTEM; C. P. Nachod, Philadelphia, Pa. App. filed Oct. 13, 1908. For a railway with electric motor car which also supplies the signaling circuit with signaling apparatus having an electromagnet which is energized at a fluctuation of voltage far below normal and a bath of oil for the winding to preserve it against heating at normal voltage.

979,094. ELECTRIC MOTOR AND CONTROLLING SYSTEM; F. B. Rae, Detroit, Mich. App. filed June 25, 1907. A series motor with a field consisting of a plurality of groups proportioned to have a maximum ohmic resistance and magnetizing effect when in series and a controlling switch for cutting out the coils of each group so as to diminish the total ohmic resistance and magnetization to increase the current flow.

979,116. TROLLEY CIRCUIT CONNECTION; C. W. Whaley, Indianapolis, Ind. App. filed July 29, 1909. For diverting the current at special places along the line to operate a sign by combining with spring contacts at intervals along the trolley wire a contact plate on the trolley pole, but insulated therefrom and connected to a local conductor.

979,143. CONTROLLING DEVICE FOR ELECTRICAL APPARATUS; E. F. G. H. Faure, Erie, Pa. App. filed Jan. 31, 1910. For portable electric tools with an electromagnetic field and handle therefor, a switch in the handle, the field maintaining the switch in closed position.

979,144. TRANSMISSION AND RECEIPT OF ELECTRICAL ENERGY; R. A. Fessenden, Brant Rock, Mass. App. filed Oct. 31, 1907. For wireless telegraph. Combines a looped conductor and an indicating instrument in circuit and a body of magnetic material arranged to divert surface current through the conductor and receiver.



979,145.—Electrical Signaling

979,145. ELECTRICAL SIGNALING; R. A. Fessenden, Brant Rock, Mass. App. filed Dec. 23, 1907. For amplifying the strength of received signals in wireless telegraphy by means of a galvanometer, a source of radiant heat, a bolometer circuit comprising a wire whose resistance alters when heated and means for directing the heat so that the shadow of the moving part of the galvanometer is thrown on or off the bolometer on receipt of signals.

979,153. ELECTRIC BATTERY CELL; J. H. Gugler, Milwaukee, Wis. App. filed June 21, 1909. A porous cup with its lower portion non-porous, a battery element within the cup which displaced the liquid and can be raised to bring the level of the liquid therein below the porous portion of the cup.

979,154. COMBINED PRIMARY AND SECONDARY BATTERY SYSTEM; J. H. Gugler, Milwaukee, Wis. App. filed Nov. 6, 1909. Accommodation of a primary battery, a secondary battery and a service circuit, all connected together at one pole of each, a switch connecting the other poles and a resistance connecting the last named poles and the two batteries.

979,155. COMBINED PRIMARY AND SECONDARY BATTERY SYSTEM; J. H. Gugler, Milwaukee, Wis. App. filed Nov. 26, 1909. Combines with a primary battery a storage battery of double the voltage permanently connected to the service circuit with a switch operated by a solenoid for alternating, connecting first one half and then the other of the storage battery in circuit with the primary and thereby charging each half alternately.

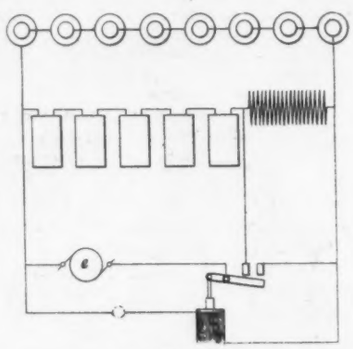
979,164. ELECTROPNEUMATIC TOOL; J. Ten Eyck Hillhouse, New York, N. Y. App. filed July 25, 1908. A plurality of magnets contained in a casing with circuits to energize the magnet and cause adjacent magnets to move to or from each other and cause the difference of fluid pressure within the casing and a piston within the casing arranged to be actuated by the fluid pressure.

979,192. MOLDING RECEPTACLE; C. D. Platt, Bridgeport, Conn. App. filed Nov. 27, 1909. Porcelain socket for attaching incandescent lamps directly to molding, including a base with grooves for the wires and an integral socket extending therefrom, the grooves deepening as they approach the middle of the base.

979,202. RAIL BOND; W. J. Randolph, Sr., and W. J. Randolph, Jr., Moscow, N. Y. App. filed July 1, 1910. A rail and fishplate with a bond for electrically connecting the rail to the fishplate, the connecting body having offset ends with detachable contact points.

979,256. TIME LIMIT DEVICE FOR ELECTRIC SWITCHES; G. A. Burnham, Saugus, Mass. App. filed Feb. 3, 1910. Controlling device for the switch operated by a rotating member and an electric motor for rotating the actuator at variable speed and for controlling the engagement of the actuator with the rotatable member.

979,275. OSCILLATION RESPONSIVE DEVICE; L. DeForest, New York, N. Y. App. filed Feb. 2, 1905. A detector having electrodes separated by a dielectric with means for heating the dielectric and a substance in it which co-operates with the heater to increase the conductivity.



979,154.—Battery System.

979,276. SPACE TELEGRAPHY; L. DeForest, New York, N. Y. App. filed Jan. 29, 1907. A circuit with an inductance in series, also a condenser and two separated arc electrodes, and antenna in the circuit and a generator of vibratory potential connected to the electrodes, the separation of the electrodes being such that the voltage rises abruptly to maximum before the condenser discharges.

979,277. HIGH-FREQUENCY ELECTRICAL OSCILLATION GENERATOR; L. DeForest, New York, N. Y. App. filed Feb. 8, 1908. An oscillation circuit including a capacity, inductance and a non-conductor, coated with a conductor of the second class, the coated element being associated with the circuit bridged across the terminal of the energy source and the capacity.

979,291. ELECTRIC SADIRON; A. H. Happe, Detroit, Mich. App. filed June 30, 1910. Heated by heating units connected together in series. The units are removable. Consist of strips wound upon flat plates.

979,292. TELEPHONE CUT-OUT; P. H. Harner, Dooms, Va. App. filed April 23, 1910. Lightning arrester with point discharge gaps and a movable base section which can be lifted to disconnect the contact members, breaking the circuit and throwing out the telephone.

979,311. TROLLEY WHEEL GUARD; E. E. Kelley, Greensburg, Pa. App. filed June 7, 1910. Prevents the trolley wheel from leaving the wire when crossing switches by using a wide contact face and friction guard wheels.

979,354. ELECTRIC SWITCH; G. Sweetser, London, England. App. filed Nov. 30, 1909. Quick make and break electric thermal switch with a bowed contact plate and a forked lever oscillated by the expansion device with its fork stranding the plate and carrying contacts.

979,363. CHEMICAL PROCESS; W. C. Arsem, Schenectady, N. Y. App. filed July 2, 1906. Mixes an oxide of tungsten with a dry powdered reducing agent and then heats the mixture in a vacuum to reduce the oxide.

979,375. METHOD OF FORMING COILS FOR ARMATURE WINDINGS; J. Burke, Erie, Pa. App. filed Dec. 29, 1906. Form a flat coil, bends both ends out of the plane of the main portion and to the same side and then forms offsets in the ends.

979,376. AUTOMATIC FIRE ALARM; L. Cain, Caledonia, Mich. App. filed March 1, 1910. Thermostatic circuit closer consisting of two wires pulled together by a spring and normally held apart by bars having their meeting ends beveled and connected by solder, which melts at a certain temperature.

979,396. THREE-WIRE SYSTEM OF ELECTRICAL DISTRIBUTION; P. H. Thomas, Pittsburgh, Pa. App. filed Jan. 21, 1903. A three-wire consumption circuit supplied from an alternating source with the neutral wire connected to an intermediate point in the source and the main conductors connected to the outer terminals, with current rectifiers in the last named connections

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Electrical World

WITH WHICH ARE INCORPORATED

The Electrical Engineer — The American Electrician

PUBLISHED WEEKLY BY THE McGRAW PUBLISHING CO., 239 WEST 39TH STREET, NEW YORK

VOL. 56, No. 26. NEW YORK, DECEMBER 29, 1910. 10 CENTS PER COPY. $3.00 PER YEAR TO U. S. AND MEXICO. $4.50 TO CANADA; $6.00 TO OTHER COUNTRIES.

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Alphabetical Index and Classified Directory second page following reading

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WEST LYNN, MASS.

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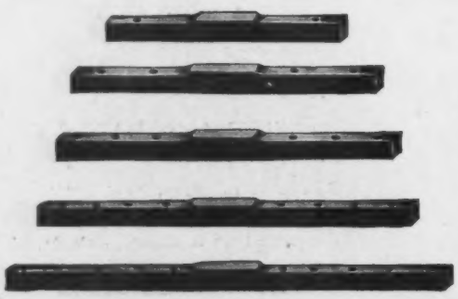

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Manufactured by

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FOR INTERIOR ELECTRIC WIRING.

GENUINE "CIRCULAR LOOM"
The Ideal Flexible Conduit.

Fishes Easily — Thoroughly Flexible Always.
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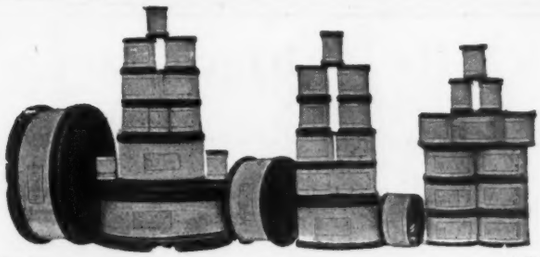

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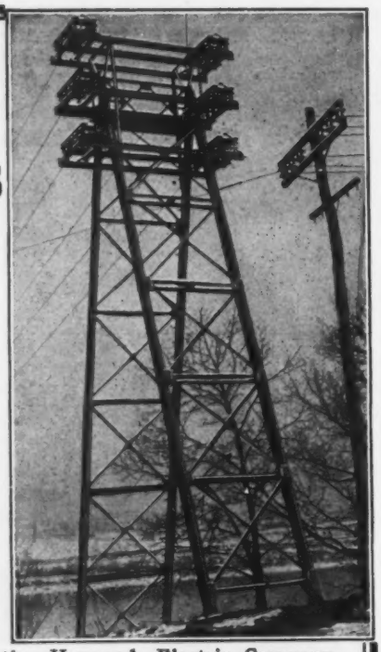

The illustration shows a 25,000-volt double three phase crossing over the east branch of the Susquehanna River, near Berwick, Pa. The crossing is approximately 2200 feet in length and the conductors are ½" 19-strand special plough steel cables. The crossing is part of a line delivering power from the Harwood Electric Company to the Columbia Power, Light and Railways Company. We designed the crossing complete, furnished the material and erected the structures, cables, insulators, clamps, etc., above the foundations.

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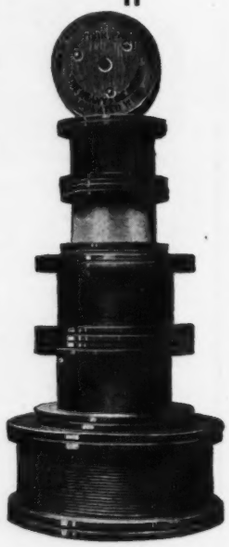

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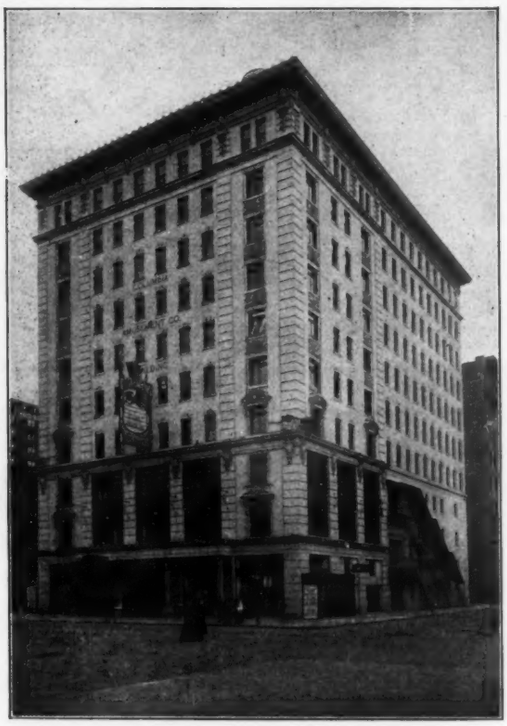

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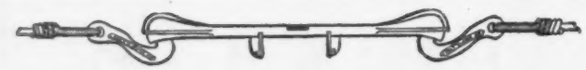

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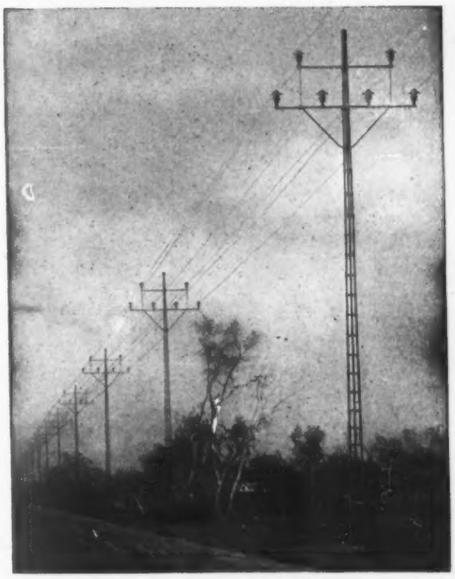

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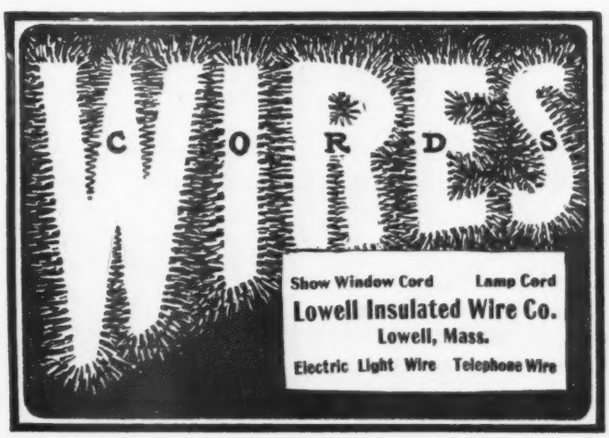

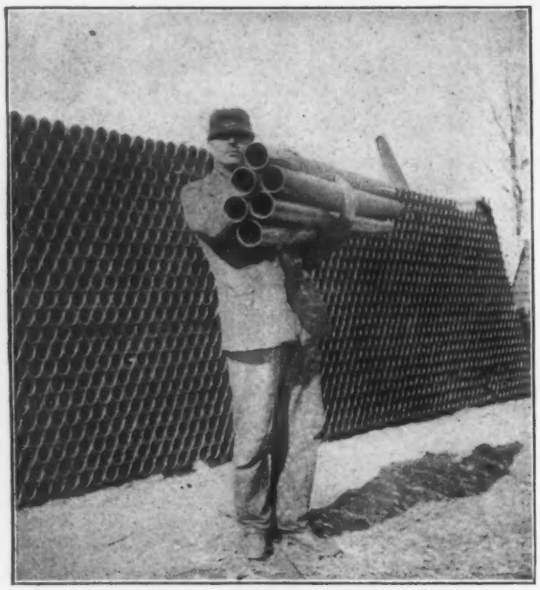

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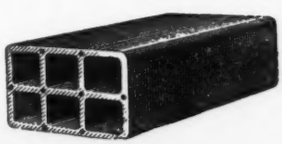

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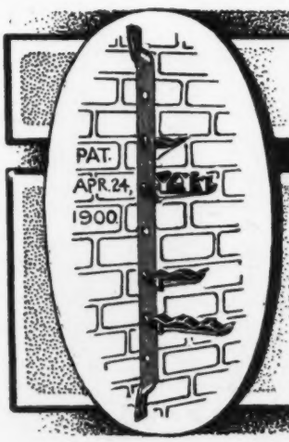

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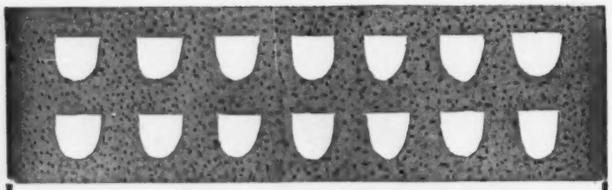

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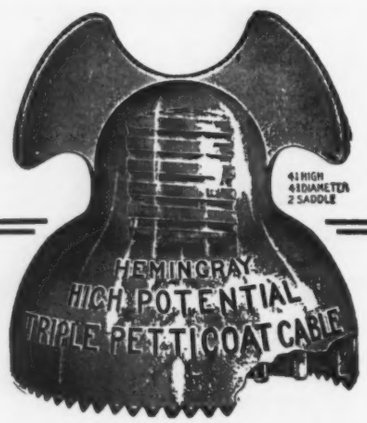

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prevent moisture from creeping from insulator to pin. Specify Hemingray. Booklet on request.

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Covington, Ky. (3) **Muncie, Ind.**

Clark Insulator Clamps

This shows Standard Type B (Pat.) for use with small standard insulators. Cast from copper, bronze or malleable iron with steel carriage bolts. Other types for every service.

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Clark Electric & Mfg. Co.
149 Broadway, New York

Marshall's Electrical Condensers

FOR TELEGRAPH, TELEPHONE, ELECTRIC LIGHT, X-RAY, EXPERIMENTAL AND WIRELESS SYSTEMS

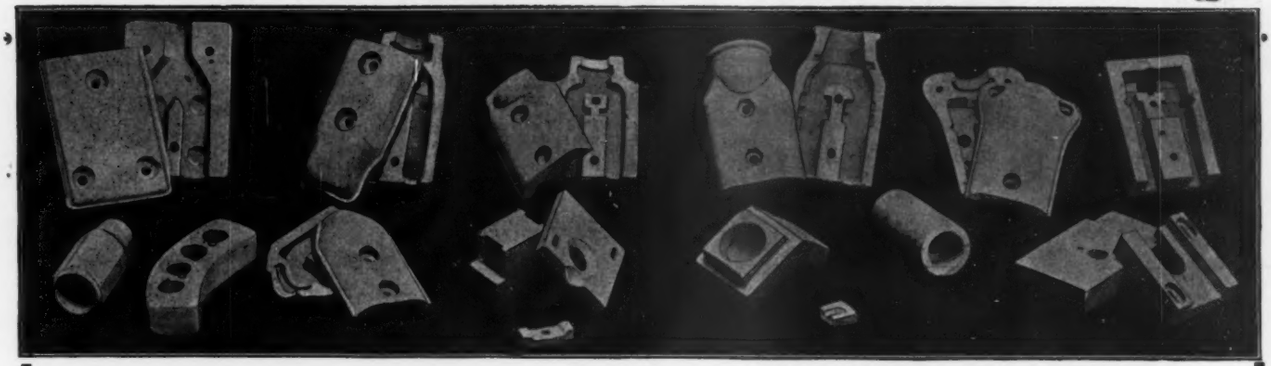
Sending Condensers for Wireless made to stand any voltage required. Standard Condensers a specialty. These Condensers are used in all Telegraph offices in America where Standard and ordinary Condensers are required. CONDENSERS AND ARTIFICIAL LINES for Submarine Cables and Land Lines. References: O. STRUBEL, Esq., Engineer Mex. Tel. Co., N. Y. J. G. MURRAY, Esq., Electrician C & S. A. Tel. Co., N. Y.

WM. MARSHALL, 709 Lexington Avenue, New York

Vacuum Drying and Impregnating Machines

Manufactured by
Buffalo Foundry & Machine Co.
52 Winchester Ave., BUFFALO, N. Y.

J-M Electrobestos Attachment Plugs



These plugs are made of a special asbestos composition, J-M Electrobestos, which is a fire-proof insulating material in almost universal use for all kinds of heat-resisting articles.

It is especially adapted for attachment plugs, handles, etc., of electric heating and cooking devices, such as electric flat-irons, coffee percolators, baking ovens, bread toasters, broilers, chafing dishes, immersion coils, curling irons, egg boilers, glue pots, griddles, heaters, all kinds of flat and solder irons, tea kettles, quick water heaters, radiators, rheostats, sterilizers, sockets, switches, wax heaters, etc., etc.,

J-M Electrobestos can be molded in tool steel dies into almost any shape. Electrically, it is very strong, one test showing it requires 30,500 volts to puncture a piece 5/8-inch thick.

The high heat-resisting properties of J-M Electrobestos make it an ideal compound for any service where mechanical and flame-resisting qualities are essential.

Special forms will be made up from blue prints. Prices, further particulars and samples can be secured by writing our nearest Branch.

H. W. JOHNS-MANVILLE CO.

MANUFACTURERS OF ASBESTOS AND MAGNESIA PRODUCTS

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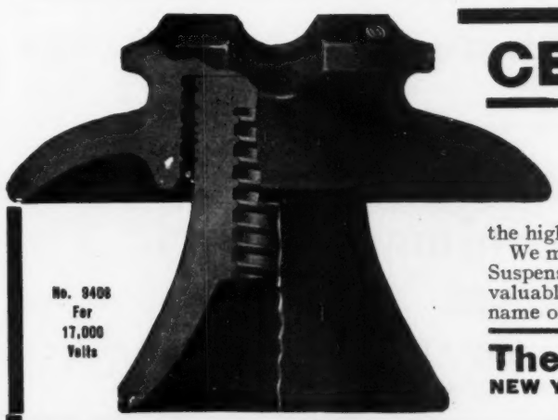
For Great Britain and Continent of Europe:—TURNERS & MANVILLE, LTD., Hopetoun House, 5, Lloyds Ave., London, E. C.



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For
17,000
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O-B Hi-Tension Insulators

are designed so that no undue stress is imposed on any one part and the porcelain is scientifically distributed so as to afford the highest obtainable efficiency.

We make Pin Type Insulators from telephone sizes to 80,000 volts and Suspension Type up to 150,000 volts. Insulator Catalog No. 10 is invaluable to all users of insulators. Write for your copy to-day and state name of your company.

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ALL KINDS

Carefully made and tested
Write for Booklet E and Prices

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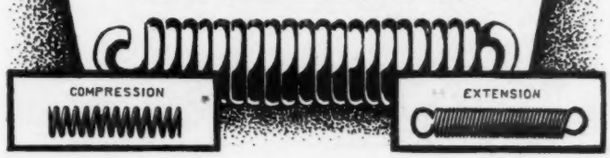

SPRING WASHERS

for use in switchboards, etc. All made to order from steel, brass or phosphor bronze.

SPRINGS

of every description for all purposes.

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Established 1857.
THE WALLACE BARNES CO.
Bristol, Conn., U.S.A. 3

MOLONEY TRANSFORMERS

the product of twenty years' exclusive transformer experience.

The transformer that for twenty years lived up to its manufacturers' claims for high commercial efficiency.

The transformer that will earn a 20% profit annually in comparison with any other transformers on the market.

Oil Cooled, Water Cooled, Air Cooled.

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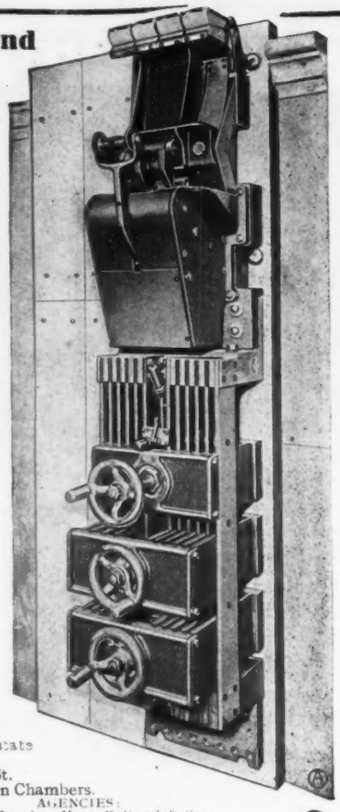
COMPLETE STOCK CARRIED WITH ALL AGENTS.

You can depend upon this Anderson Semi-Remote Control Switch



to open from distant point, by solenoid mechanism in emergency cases.

Absolutely reliable and quick acting.

Hand Closed.

Requires 3½ amperes to operate.

Anderson Switch and Switchboard experience covers twenty years.

Let us figure on your requirements.

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There Are No Strings

attached to our proposition. When we say we will take care of all your transformer repair bills for from 2 to 5 years, we mean it, and we will live up to both the letter and the spirit of the statement.

Say the word and we will send you a transformer on approval for thirty days.

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First impressions on consumers should be favorable—

One of the most important things a Central Station can do favorably to impress a new customer is to get him connected up promptly after he signs his contract. You can give new service immediately by carrying a few

Peerless Transformers

in stock. Makeshifts are dangerous; so are delays. You avoid both of these dangers by the simple expedient of ordering your Peerless Transformers in advance.

We make all kinds, including house-lighting and sign-lamp transformers. Our guarantee backs every one. Will you have our proposition showing the dollar-and-cents advantage of this plan?

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"Transformers of all kinds for all purposes"

THE AUTOMATIC

is a common sense clothes washer for common sense people. Reversible wringer, ball-bearing casters, brass hose-bibb, gear drive and many other valuable features make this the *one* machine Central Stations may sell without fear of calls for the trouble men."

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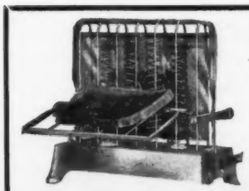

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makes a piece of delicious crisp toast in 45 seconds. Most efficient, convenient, and durable toaster made. Our prices will interest you.

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Why Not Save 75%

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Save at the period when most necessary for Central Stations.

The economy will show your customers that their interest is yours—that current sales do not mean selling more than one needs.

Packard Mazda Transformers are neat and compact *with substantial cast-iron cases. Can be mounted in any position—outside on the sign itself, to save long, heavy lead wires.*

Write for new Packard Catalog No. 10, covering complete line of Packard Central Station Lighting and Power Transformers.

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Station Batteries. Line or Floating Batteries. Commercial and Pleasure Vehicle Batteries. Telephone Batteries. Fire Alarm and Signal Batteries. Inquiries invited.

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INTEGRATING WATTMETERS
TYPE D DIRECT CURRENT
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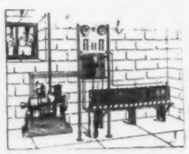
SANGAMO
SERVICE and SWITCHBOARD TYPES
AMPERE HOUR METERS
SANGAMO ELECTRIC COMPANY SPRINGFIELD, ILL.



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DAY AND NIGHT SERVICE
The Junior No. 1 Equipment
Direct Connected Dynamo, Gasoline Engine Set, Complete Switchboard, 16-Cell "American" Storage Battery } $265
The most complete, reliable equipment ever offered at this price.
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Motor Starters and Controllers
No Dash-Pot
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MILWAUKEE, WISCONSIN
Direct Current Alternating Current

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We Are the Only Makers of Graphite in the World.

WILLARD STORAGE BATTERIES
FOR ALL PURPOSES
Manufactured by
The Willard Storage Battery Co.
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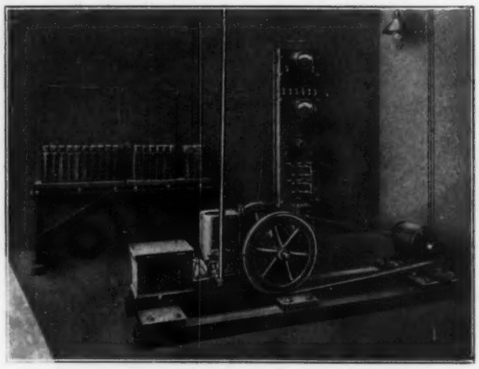

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There is a rapidly increasing demand among owners of suburban homes, farms, and factories, not near a Central Station for electric light and power. This Company has designed isolated electric plants using Tungsten lamps, which consist of gas engine, dynamo, storage battery and switchboard, which are inexpensive and absolutely reliable. The battery used is

The "Chloride Accumulator"

This is exactly the same type of battery as is furnished for the Central Stations, Railways, Telephone and Telegraph Companies. The sale of these plants is very desirable business for electrical dealers. Write any Sales Office for full information.

THE ELECTRIC STORAGE BATTERY CO.

1888 PHILADELPHIA, PA. 1910

New York, Boston, Chicago, St. Louis, Cleveland, Atlanta, Denver, Detroit, San Francisco, Toronto

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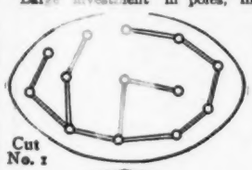
THIS ADVERTISEMENT IS WORTHLESS UNLESS YOU ARE WILLING TO BE SHOWN

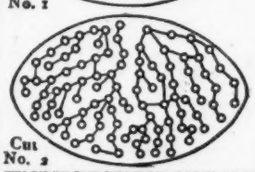
Cut No. 1 represents your residence lighting conditions at the present time. Large investment in poles, lines and transformers, with an occasional installation here and there



Cut No. 1

Our records, the census reports and electrical authorities agree, that the present proportion of houses using electricity for lighting to those who do not, is in the ratio of 1 to 10

Cut No 2 represents the improved conditions of residence lighting due to the establishment of a controlled flat rate in connection with Mazda Lamps and Excess Indicators



Cut No. 2

If your present residence conditions suit you, it is useless to argue the question further, but we are looking for broad-minded Central Station men who recognize the situation, and who are honestly willing to do their part to increase their business, revenue and profits

The improved conditions above referred to, have been obtained in every city now under contract with us, list of which with details of results, will be supplied on request

EXCESS INDICATOR COMPANY, 241 West 42d Street, New York City

KENT POCKET METERS

THE STANDARD BATTERY TESTERS

Hand graduated—accuracy guarantee.
Dead beat—quick reading.
Unbreakable celluloid window.

Combination Volt-Ammeters

(To read amperes press button)

0-6 volts, 0-30 amperes, $6

0-10 volts, 0-30 amperes, $7

Voltmeters, 0-9 volts, $4. 0-20 volts, $5

Ammeter, 0-30 amperes, $4

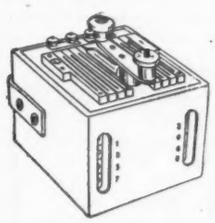
ATWATER KENT MANUFACTURING WORKS

34 North Sixth Street **Philadelphia, Pa.**

QUEEN

ELECTRICAL MEASURING INSTRUMENTS

PHILADELPHIA



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Portable loading devices for testing

A-C Meters
Light—Compact

H. J. Blakeslee, Syracuse, N. Y.

Battery Testing Instruments

that are well made and accurately calibrated. Watch type—light weight. In leather case for carrying.

ELDREDGE ELECTRIC MFG. CO. 1

103 Post Office Square **Springfield, Mass.**

An Advertiser in Our Classified Column Writes:—

We want to congratulate you on the results of our one time adv. which brought forth intelligent replies from all over the country and England.

Cannot Damage Metal

U. S. Metal Polish is easily applied, work quickly and produces a lustre that lasts. Established 16 years. Agents and dealers everywhere.

3 oz. box, 10 cents. 5-lb. pail, $1.00. Sample Free

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ITS new features will interest you.

The CROSS

INSULATED STAPLES

Waterproof. Double thickness of insulation. Without break under head.

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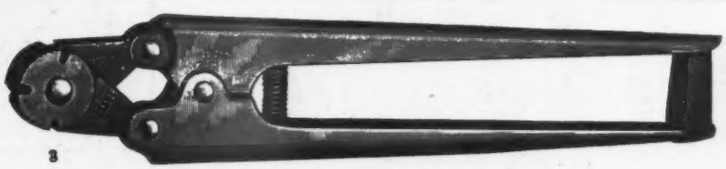
The Hardest Jobs

of wiring are made easy by the Hargrave Compound Lever Wire Cutter. Built for work, not for looks. MAY WE SEND OUR CATALOG?

Send four cents to cover postage

The Cincinnati Tool Co., Cincinnati, Ohio



3

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Found only in "National" Vehicle Batteries

1st: The "National" Bolt Connector. On request "National" batteries are furnished with cells joined together by bolt connection—an exclusive "National" feature—obviates lead burning. Cells are easily disconnected, inspected and replaced without the aid of an expert lead burner and his outfit. **Only tool needed—a monkey wrench.**

2nd: High-Bridge jars. Where height of battery space permits, "National" battery jars are supplied with three-inch bridges. Necessity for frequent cleaning and removal of sediment is done away with. Mud space is ample to accommodate all sediment during life of plates. **No washing!**

3rd: Choice of standard, medium or thin plates: "National" plates are of three thicknesses. Experience with the medium and thin types during the past year insures the success of the electric passenger and commercial vehicle. "National" thin plate cells with practically no increased weight have a **capacity 55% greater** than cells with standard plates. Good life of plates is being obtained as well as greatly increased mileage.

The Most Important Improvements Ever Made in the Vehicle Battery

Send for Bulletin No. 102—Let us talk it over with you

The United States Light and Heating Co.

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New York Boston Buffalo Cleveland Chicago St. Louis San Francisco

Campbell

Transformers

FOR

TRADE LOWVOLT MARK

TUNGSTEN LAMPS

AND FOR

Any Other Purpose

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YOU ALL HAVE USE FOR SPECIAL TRANSFOR-MERS

JUST GIVE US AN IDEA OF WHAT YOU WANT

Approved by the Underwriters

Write us TO-DAY—Do it NOW

Campbell Electric Co., - Lynn, Mass.

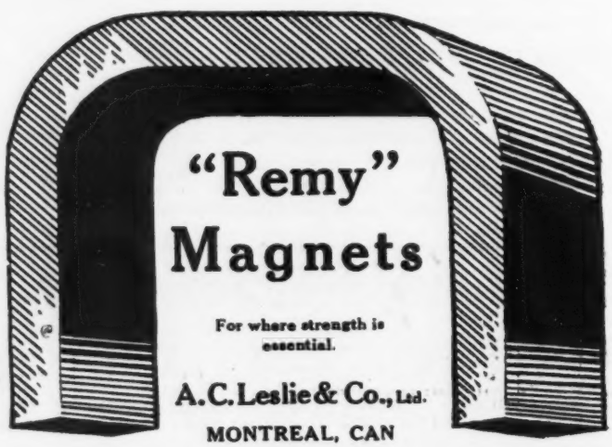
CAMPBELL { TIME SWITCHES—BELL RINGERS
X-RAY AND HIGH-FREQUENCY APPARATUS
THERMO FLASHERS

The Guaranteed Cell

The list of satisfied **"Red Seal"** customers is growing larger each day. A trial is assuring. A comparative test with other makes is convincing that our **Satisfaction Guaranteed** cells will do all we claim for them.

Manhattan Electrical Supply Co.

NEW YORK 17 Park Place CHICAGO 188 Fifth Avenue



"Remy" Magnets

For where strength is essential.

A. C. Leslie & Co., Ltd.

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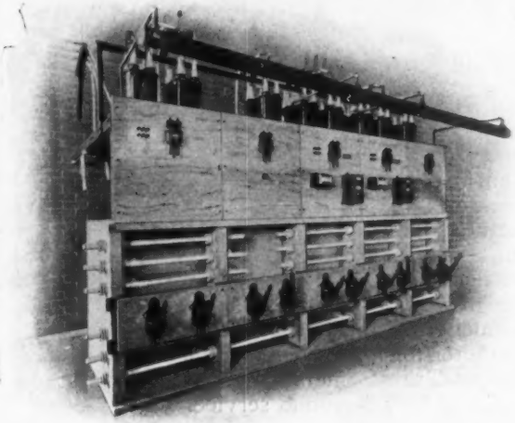
A Big Central Station Couldn't Synchronize



when the engines were the least bit out of order.

After careful investigation, the engineer in charge located the trouble in the switchboard.

This was discarded, and a

CONDIT

Double-bus-bar board was installed in its place.

No amount of engine trouble interferes with synchronizing now.

This is just one example of the sort of service we are rendering to Central Stations and private plants all over the country.

We are specialists—put your switchboard problems, and all your other protective problems, up to us.

We have the apparatus that will meet your requirements.

Shall we send catalogs?

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Manufacturers of Electrical Protective Devices

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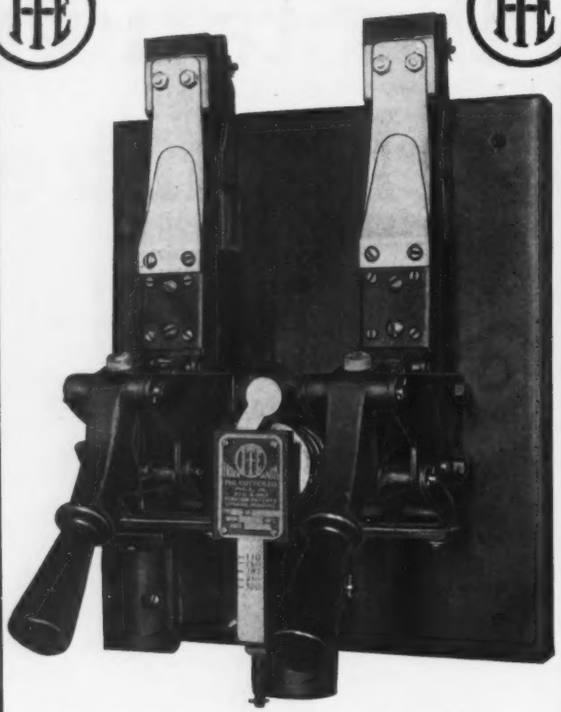

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Occasionally someone says, we are using such and such a circuit breaker and it has given us no trouble. This may be so but has it been subjected to the test of a severe short circuit which may occur any minute? Under normal conditions a circuit breaker has nothing to do but to carry its rated current without undue heating but any instant it may be called upon to open under a short circuit condition which may threaten the existence of a generator worth thousands of dollars. This is the test. To-morrow you may wish you had bought an I-T-E Circuit Breaker to-day.

THE CUTTER COMPANY
PHILADELPHIA

For One Hundred and Eighty Days

the armature and permanent magnets used in

Duncan Meters

are prepared and aged to insure *permanent accuracy.* Every other element and process of manufacturing Duncan Meters is treated with the same consideration.

The predetermined and allotted time for production is consumed to the advantage of the meter for long lived accuracy.

Duncan Transformers warrant the highest efficiency for all-around service.

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DUNCAN Electric Mfg. COMPANY
Lafayette, Indiana

Our New Float Switch

Made in Single, Double or Triple Pole.

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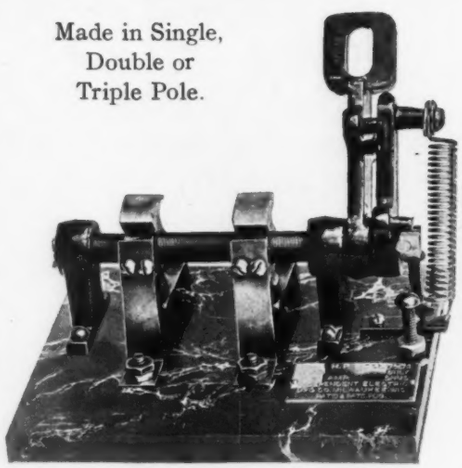

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Can be placed in any position, and will operate to your entire satisfaction.

Write for Catalog.

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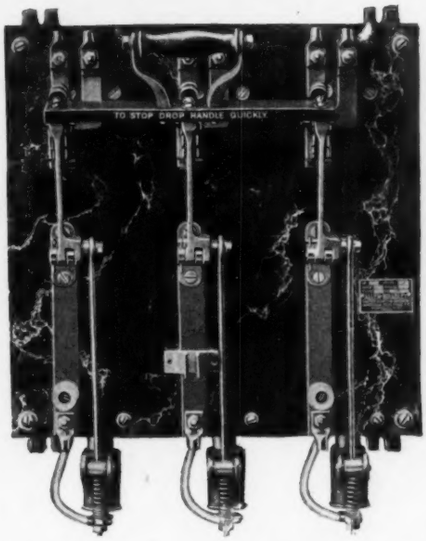
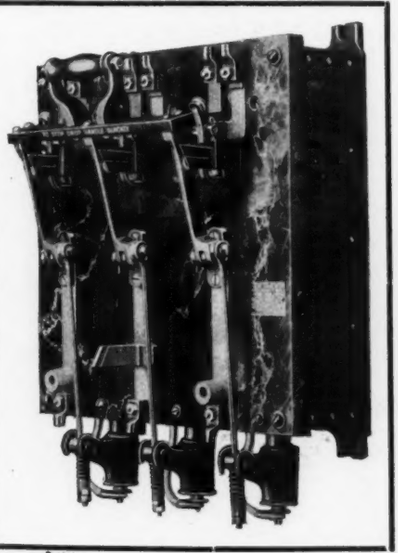
The three elements



QUALITY EFFICIENCY SERVICE



are found in our

COMPRESSION TYPE

Induction Motor Starters. **Ask for Bulletin 321.**

AMERICAN ELECTRIC FUSE CO.

Dept. 4.

Muskegon, Michigan

Atlanta, Chicago, Cleveland, Denver, New York, Philadelphia, Pittsburg, St. Louis, San Francisco, Seattle, Washington, Toronto

WARD LEONARD

Line Rheostats for Plating Machines

TYPE "PL"

The rheostats are built for universal control, or individual tank control, and each has five or more switches, giving at least thirty steps of control.

Any desired number of amperes can be obtained by closing the proper switch or switches—each switch is marked with the number of amperes that will flow when it only is closed.

Each resistance, with its controlling switch, is designed to be connected across the full generator voltage. Overloads and burnouts are impossible, as each resistance is designed to carry all the amperes that the maximum voltage can force through them.

Write for detailed information.

WARD LEONARD ELECTRIC CO. **Bronxville, N. Y.**

The "Quick Samson"

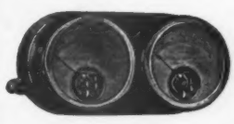
Strand or Messenger Wire Grip

2 Styles, Trolley and Messenger wire

Never enough strain at any one point to crush or injure the wire. Arrangement of tackle rings insures straight pull. Easy to handle and will carry any strain necessary to tighten the wire. Excellent Testimonials by users on file. Catalog describing our entire line mailed for 3 cents in stamps.

Mathias Klein & Sons

Station U 32, Chicago, Ill.



A distinguishing, we might almost say exclusive, feature of the

HOYT

Line of

Ammeters and Voltmeters

is their extreme flexibility, adapting them to practically every use required in modern practice.

Ask for Bulletin E.W.

Hoyt Electrical Instrument Works

Penacook, N. H.

Sales Offices:

161 Summer Street, Boston, Mass. 136 Liberty Street, New York, N. Y. 80 Michigan Avenue, Chicago, Ill.

Save Time in Meter Testing

Make tests without removing meter cover or interrupting service.

Meter Blocks and Cabinets

Wired from either direction.

Terminals and connecting wires are sealed against tampering or theft of current.

Interchangeable case covers to fit all meters.

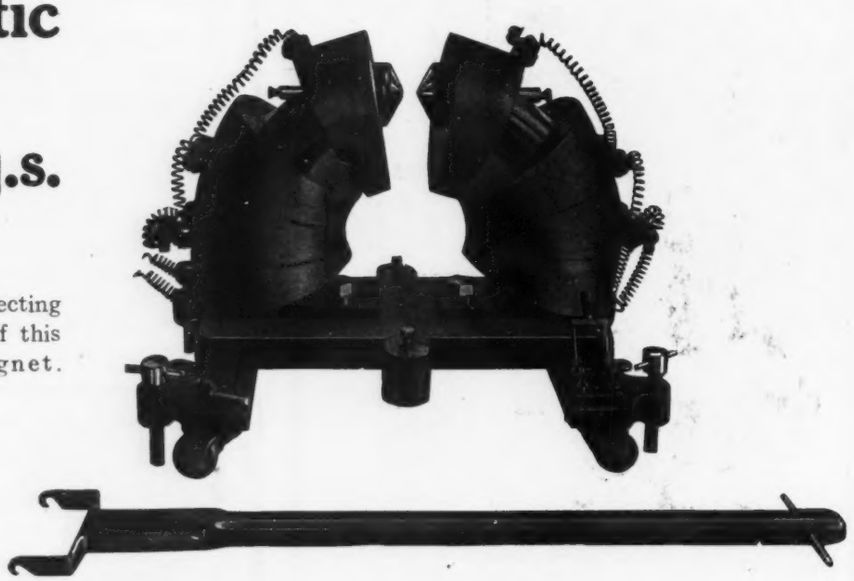
Blocks and Cabinets protect the Central Station and Prevent unauthorized alteration of line or abuse of service wires and service fuses

All styles and sizes for power or lighting service.
Write for bulletins.

The Hart Manufacturing Co.
HARTFORD CONN.

A Magnetic Field of 50,000 c.g.s. Lines

can be produced by connecting in series the eight coils of this semicircular electromagnet. The coils may readily be connected in series or in parallel, or used singly. The base is accurately planed and scraped, and is provided with levelling screws.

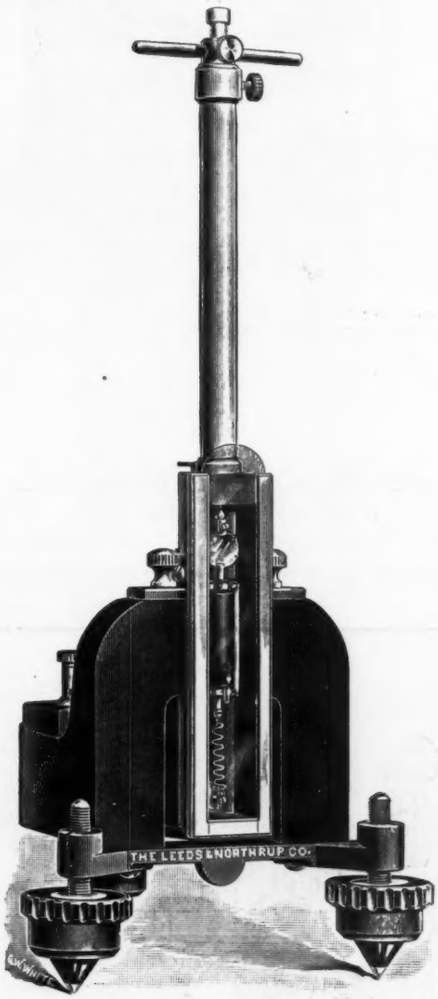


This apparatus is well adapted to a wide range of experiments involving magnetic fields. Write for full particulars.

W. & L. E. GURLEY, - TROY, N. Y.

Leeds & Northrup Galvanometers

A complete line of galvanometers enables us to meet almost any requirement in this line.



HIGH SENSIBILITY GALVANOMETER

Resistance 30 ohms to 1600 ohms. Sensibility up to 1600 megohms. May be used ballistically. System easily accessible. Suspensions quickly replaced.

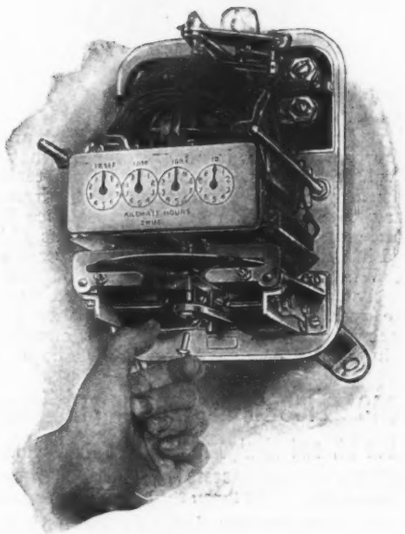
Our Pamphlet No. 3 contains much valuable data and information upon the subject of galvanometers. A copy will be sent upon request.

The Leeds & Northrup Co.

Electrical Measuring Instruments

4903 Stenton Ave. Philadelphia

Do you ever have any trouble with your meter bearings?



Columbia Meters

won't bother you that way.

The extremely light slow speed armature imposes only nominal duty on the jewel. The center of gravity of the moving element is low, minimizing side pressure on the upper bearing. The design permits the jewel to be removed for inspection and replaced in five seconds by the stop watch without the use of any tool. (See illustration)

The pivot similarly is completely accessible on unscrewing a single unit.

Columbia Meters do not require tinkering. When they are up for inspection, the work is easy, quickly done and goes through with the assurance that no adjustments have been upset in the process.

COLUMBIA METER CO.

Indianapolis, Indiana

MACHADO & ROLLER

Sales Agents

Monadnock Block Chicago | **203 BROADWAY NEW YORK CITY** | **Oliver Building Pittsburg**

KEYSTONE QUALITY

This Keystone portable ammeter for direct and alternating-current circuits is an example of what careful design will accomplish. To make an ammeter suitable for measuring both direct and alternating currents, it is necessary to secure almost perfect balance between inductance and capacity. So closely has this been obtained in this case that no appreciable error is introduced. When the frequency of circuit is specified, we can supply these instruments guaranteed sufficiently accurate even for scientific testing. Other Keystone instruments for every service and every circuit are described in Catalog 14. Better write for a copy.

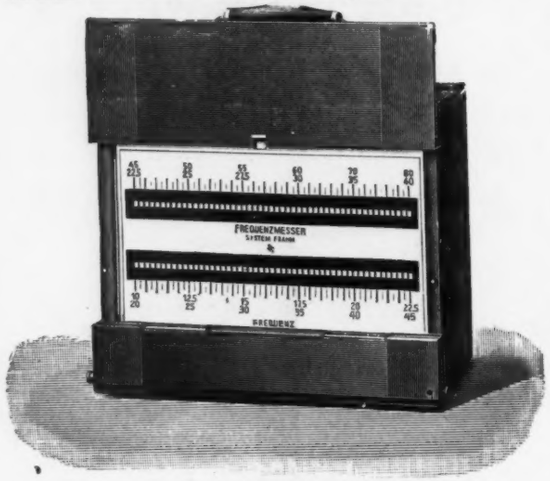
Keystone Electrical Instrument Company

9th St. and Montgomery Ave., Philadelphia

NEW YORK	BOSTON	PITTSBURG
Hudson Terminal Building	170 Summer Street	Westinghouse Building

Frahm Frequency Meters

Resonance Type



Put up in portable and switchboard mountings, these instruments are accepted by prominent engineers as the **most reliable** frequency meters on the market. A high initial accuracy **is maintained for years,** without recalibration.

Frahm instruments are made by Siemens and Halske, which is ample guarantee as to design, material and workmanship.

Write for Illustrated Bulletin 726

JAMES G. BIDDLE

Sole Agent for the United States

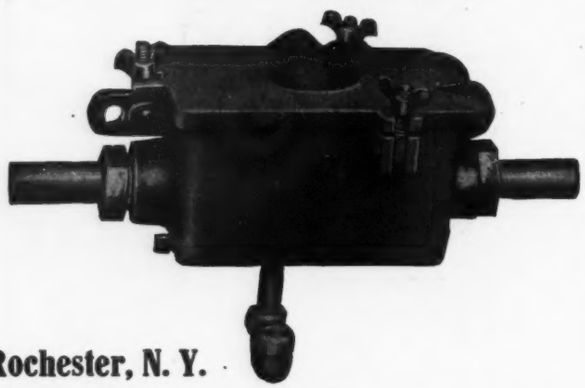
1114 Chestnut St. Philadelphia

Are You Having Trouble on Your

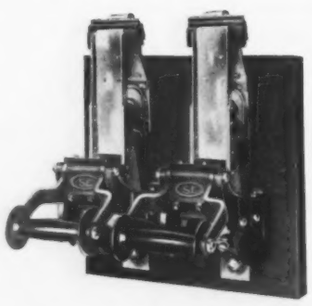
A. C. Distribution?

The Rochester Oil Fuse

does for overhead and underground systems what the oil switch does for the switchboard. Our new bulletin describes it in every detail and is gladly mailed to those who ask for it. Write



The RICKER MFG. Co. 300 N. Water St., Rochester, N. Y.



Roller-Smith Company

MAKERS OF HIGH GRADE

Electrical Measuring Instruments

AND

Automatic Circuit Breakers

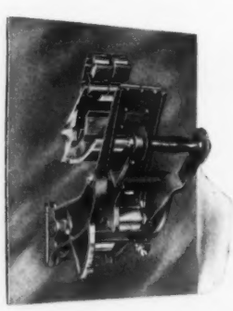
GENERAL SALES AGENTS

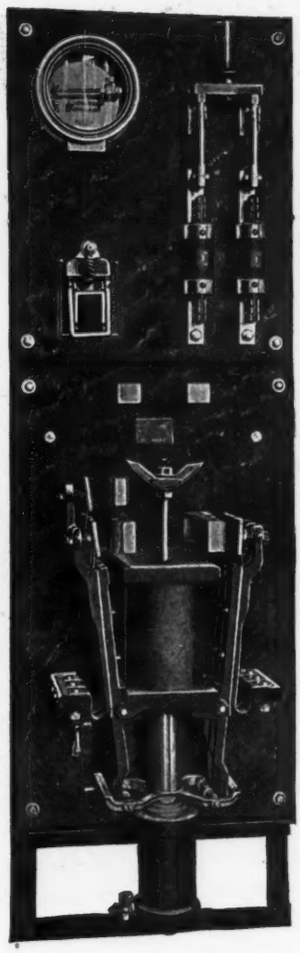
MACHADO & ROLLER

203 Broadway

New York

Branch Offices in Chicago and Pittsburg.
Agencies in Principal Centers.





Space, Labor and Expense are Saved

by this Sundh 50 H P. 220-volt Controlling Panel—a combination of a Sundh Automatic Starter with main line switch and fuses and a Sundh Pressure Regulator.

There are no sliding contacts to stick or get out of line. The entire outfit is the embodiment of simplicity, strength and reliability.

Send sketch or blueprint, with specifications, and we will quote.

Meanwhile, ask for the Sundh Catalog.

Sundh Electric Company

New York, U. S. A.

3

Code No. 903

Inter-Comm-Phone

NON-FLUSH wall telephone in oak woodwork. Automatic key in three sizes—twelve, twenty-two and thirty-two station capacities. Long distance transmitter and receiver. Accessible and simple to install.

More Inter-Comm-Phones of this type are used than all others. For general purposes it meets all the requirements for office, factory and house use.

The cabinet hinges open from the backboard, on which the No. 160 Automatic Key is mounted in the most accessible position. Designation strips may be easily placed under key face plate opposite each button without removing any of the key parts.

Send us plans of your factory or residence and let us submit the most practicable telephone system for your purpose.

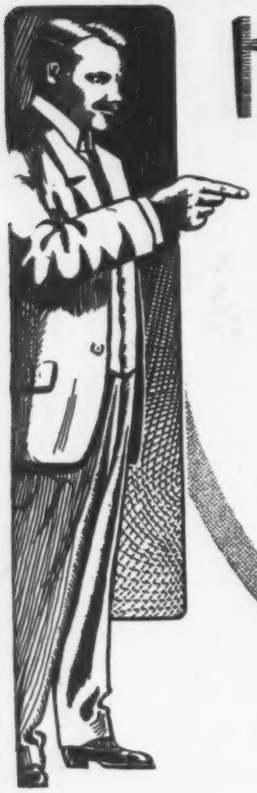
Booklet No. 201 Gives Data.

STROMBERG-CARLSON TEL. MFG. CO

ROCHESTER, NEW YORK, U.S.A.

CHICAGO, ILL. KANSAS CITY, MO.

ELECTRICAL SUPPLIES



How About It?

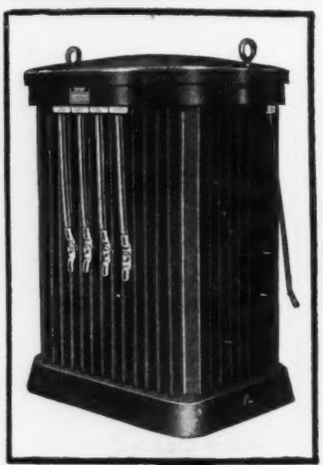
DON'T DELAY ANY LONGER

Make up your mind to investigate the Central Service. You run no risk dealing with a concern who has served the trade for 23 years, and today carry the largest and most complete stock of all standard material and improved apparatus in the Middle West. If you want quality goods and at the right price, send us the trial order NOW.

Central Electric Company,
264-266-268-270 Fifth Ave., CHICAGO

Central Electric Company · OKONITE · OKONITE · Chicago

No This is Not the Largest Transformer Ever Built



but we honestly believe, that everything considered, it is the best purchase on the market. All we want is a chance to prove it.

Because a steel mill can cast a cannon that will shoot 25 miles does it necessarily follow that they make the best pocket pistols?

Now when it comes to buying transformers you want to get something more than just size, and that's where we are strong.

We couldn't begin to tell you here, all the reasons why

Fort Wayne Transformers Are Superior

but we have a Bulletin 1118 that goes into details on the subject.

The various subjects of core loss, temperature, regulation, insulation, safety, reliability, economy, etc., are discussed thoroughly and it is clearly explained how we have solved these problems with our Type A transformer.

If you want transformers that will continue year after year to give you the same efficient service as when they are installed it will pay you to send for this Bulletin, and investigate our claims.

"Wood" Systems FWEW Fort Wayne, Ind.

FORT WAYNE ELECTRIC WORKS
"Wood" Systems
1609 Broadway, Fort Wayne, Ind.
Branch offices in most large cities

Trumbull New Porcelain Specialties

Attachment Plugs

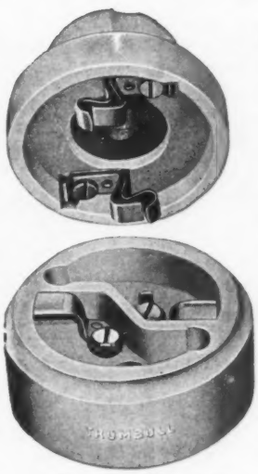
Cat No. 920, Porc. Cap
Cat. No. 921, Composition Cap

Smallest Plug on market. Made with porcelain and composition cap. Contact pins guided to holes by groove. Can attach instantly. No arc. Stood without heating under test of 23 amperes, 220 volts.

Get Sample

Tungsten Rosettes

With Shock Absorber

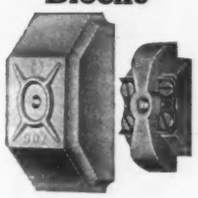


Cat. No. 756, Concealed

Rosette designed for use with Tungsten Lamps. Laminated cotton felt cushion takes support off lamp and eliminates all vibration from lamp filament, allowing Tungsten lamps to be used in factories and lofts. Cap fits base of any Trumbull Fuseless Rosette.

Get Sample

Splicing Blocks



Cat. No. 907, 2 wire

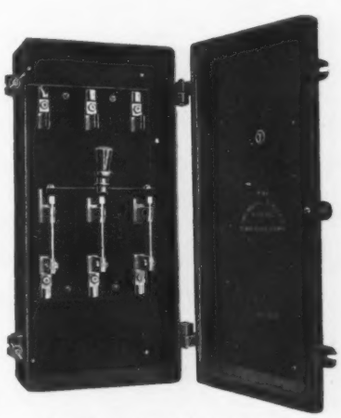
Completes our Moulding Branch Block line. For straightaway work where splicing was formerly necessary. Underwriters allow no joints or taps in moulding unless protected by fittings. *Get Sample*

Cat. No. 1211, Box Only

New Iron Service Boxes

With or Without Switches

No neater, more substantial or complete a line on market.



Cat. No. 13040, Switch in Box

Trumbull Electric Manufacturing Company

Plainville, Conn.

New York	Boston	Philadelphia	San Francisco
136 Liberty Street	76 Pearl Street	38 No. 110th Street	84-88 Second Street

SIMPLEX
ELECTRIC TOASTERS

(with new "Keep-Hot" Rack as illustrated. In sight only when in use.)

Simplex Electric Dining Room Sets—the only Combination requiring but one heating unit—Coffee Urns, Chafing Dishes—Water Cups, Toasters, Travelers' Stoves, Heating Pads, Baby Milk Warmers and Household Irons are practical necessities and should be in use in every well-equipped household.

Let us help you make them so.

Display these devices; suggest them to your customers and start the solid Simplex foundation of service and satisfaction in Electric Household Help, which means more customers, new consumers and more current sold.

Write for Advertising Help.

See our exhibit at the Electrical Show, Coliseum, Chicago, Jan. 7th to 21st. (inc.), 1911.

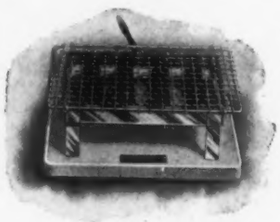
SIMPLEX ELECTRIC HEATING CO.
CAMBRIDGE, MASS.
Monadnock Block, Chicago
No. 612 Howard Street, San Francisco, Cal.

THE DELCO HIGH EFFICIENCY

Electric Heating and Cooking Devices are built for the Consumer. Built to give satisfaction in original cost, in service and in cost of operation.

For example:

The Delco Toaster will produce more toast per kilowatt hour than any other electric toaster. Try it.



Write for booklet.

DIAMOND ELECTRIC CO.
BINGHAMTON - - - NEW YORK

Household Current Consumption

for cooking as well as lighting, is *the ready means of increasing day load* of Central Stations—and the

Quad Electric Stove

and Fireless Cooker is the easy means of introducing the housewife to the conveniences of everyday use of electricity.

Cooks four articles simultaneously on one heater, and the results are pleasantly surprising. Every Cooker installed means an increase in yearly income of not less than $30.

The price—$25, with liberal discount proposition to Central Stations.

Write for details now.

A. L. Sykes Mfg. Co.
129 E. Pearl St., Dept. E, Cincinnati 3

You can readily change alternating current to direct current by means of a Westinghouse-Cooper Hewitt Mercury Rectifier, and use the rectified current for operating all types of direct-current series arc lamps, as well as Westinghouse Metallic Flame Arc Lamps, for which it is specially adapted.

75 Light Westinghouse Cooper Hewitt Rectifier

Westinghouse Cooper Hewitt Mercury Rectifiers

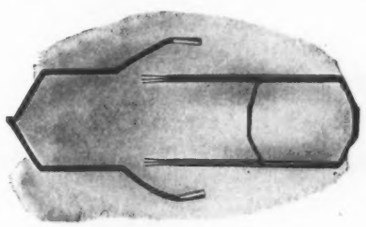
Metallic Flame Lamp

operate noiselessly and efficiently and give excellent regulation. They make unnecessary the use of high-speed machinery, such as small generating units driven by high-speed engines; by belt and line shafting from a large prime mover; or by motor-generator sets. The step-down transformers often required with a motor-generator arc-lighting set are also eliminated, as the rectifiers can be connected directly to any high-tension line operating at less than 13,800 volts.

Read all about them in Circular No. 1155

Not to be impertinent—but

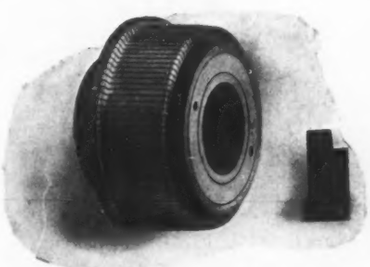
are you obtaining the best results with the coils, commutators, brushes and other supply parts you are now using?



Armature Coils

Westinghouse Coils

fit the slots for which they are intended—no pounding into shape, with the consequent breaking of insulation between turns.



Commutator and Commutator Bar

Westinghouse Commutators

have unsurpassed wearing qualities, are made of hard drawn copper of uniform density, and the best grade of amber mica, which is sealed with the highest quality of bond obtainable, consequently there are no high spots on the commutator—no pockets in the mica to cause pitting, or uneven wear.

Westinghouse Electric & Mfg. Co.

Atlanta Boston Chicago Denver Kansas City New Orleans Philadelphia St. Louis San Francisco
Baltimore Buffalo Cincinnati Detroit Los Angeles New York Pittsburg Salt Lake City Seattle
Westinghouse Elec. & Mfg. Co., of Texas, Dallas and El Paso, Tex.
Canada: Canadian Westinghouse Co., Ltd., Hamilton, Ont.
Mexico: Compania Ingeniera, Importadora y Contratista, S. A., successors to G. & O. Braniff & Company, City of Mexico.

The Cutler-Hammer Iron
The iron for practical people

Sleeve Iron—3 lbs.
Has detachable handle. Convenient for Travelers

CUTLER-HAMMER

ELECTRIC IRONS

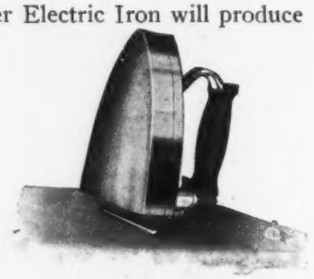
please the user. Every feature of service has been considered in their design.

A heavy storage plate is provided above the heating unit with an air space between this and the top plate. This layer of air holds the heat in the iron, allowing it to be conducted only to the ironing surface and impending its conduction and radiation to the top of the iron.

There are no soldered connections; the contact posts are riveted directly to the heating element. Heating elements are guaranteed for one year and are easily placed in position by anyone.

For good everyday ironing the Cutler-Hammer Electric Iron will produce the quickest work with the least expense—because of the uniformly heated ironing surface and unusual heat retaining qualities.

Send for our 32-page Booklet which describes our entire line of electric heating devices.



Household Iron
Made in 5, 6 and 7 Pound Sizes
No Stand Required

The Cutler-Hammer Mfg. Co., Milwaukee

NEW YORK: Hudson Terminal (50 Church St.)
CHICAGO: Monadnock Block.
BOSTON: 176 Federal St.
PHILADELPHIA: 1201 Chestnut St.
PITTSBURG: Farmers' Bank Bldg.
CLEVELAND: Scofield Bldg.
PACIFIC COAST AGENTS: Otis & Squires, 155 New Montgomery St., San Francisco.

A Live One **For Dealers**

SHALER ELECTRO-PAD

Here is an article that appeals to the mother of the home—the readiest buyer in the country. The appeal is direct to her comfort and the comfort of her family. There is need for a Shaler Electro-Pad in every home equipped with electric lights. Its field is not limited to any one class as is that of the electric iron, which is of use only to those who do their own laundry work.

Let us tell you how the Electro-Pad relieves tooth ache, head ache, indigestion, neuralgia, sciatica, croup, lumbago and a number of other ailments.

Write us to show you how we help you sell Electro-Pads.

C. A. SHALER CO.
31 Fifth Ave., Waupun, Wis., U. S. A.

ELECTRIC SEARCH LIGHTS

7 inch to 36 inch diameter for ocean, lake and river steamers and launches; also electric light plants driven by gasolene engine for isolated lighting.

The Carlisle & Finch Co.
228 E. Clifton Avenue
CINCINNATI, OHIO

The Flexlume Day-Night Sign

Visit our exhibit at the great Electrical Show, Chicago Coliseum, beginning Jany. 7th, 1911. Booth is near exit B.

FLEXLUME SIGN CO.
Liverpool, England Buffalo, N. Y. St. Catharines, Ont.

Hang Your Arcs on Silver Lake

The Standard Cord for over 40 years.

Silver Lake Co.
Boston, Mass.

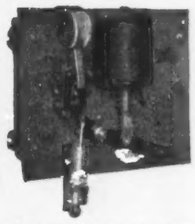
CUTLER-HAMMER

A.C. Motor Speed Regulator.

Enclosed Type D.C. Motor Starter.

A.C. Single-Phase Motor Starter.

A.C. Polyphase Motor Starter, Face - Plate Type.



D.C. Self-Starter for Automatic or Remote Control.

ELECTRIC CONTROLLING DEVICES

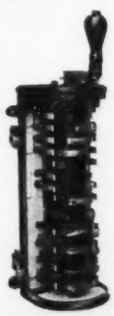
UPON the proper choice of control the satisfactory operation of your motor largely depends. In many motor applications the output can be greatly increased by providing controlling devices which will permit of the most convenient control and obtain at all times the speed desired for most efficient work.

If you have any problem involving the starting, stopping or speed regulation of electric motors (whether operating small sewing machines or big rolling mills) write us.

We make the largest line of electric controlling devices on the market, including apparatus for both direct current and alternating current motors and for manual, automatic and remote operation. The files of our engineering department are filled with data on motor control.

Our experience in the design and manufacture of electric controlling devices extends over a period of nearly twenty years.

If you know the result you wish to accomplish, but are not sure of the best means of obtaining this result, put it up to our engineers. Their advice is at your service. They will outline the best method of accomplishing the result you desire, and advise you as to the apparatus needed. If you already know what apparatus you require let us quote to your specifications.

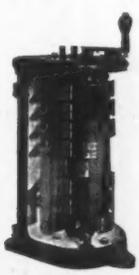


A.C. Drum - Type Controller (cover removed).

Carpenter Type D.C Controller for Printing Presses and Machine Tools.

Six-Inch Speed Regulator for Small Motors, 1/20 to 1/6 H.P.

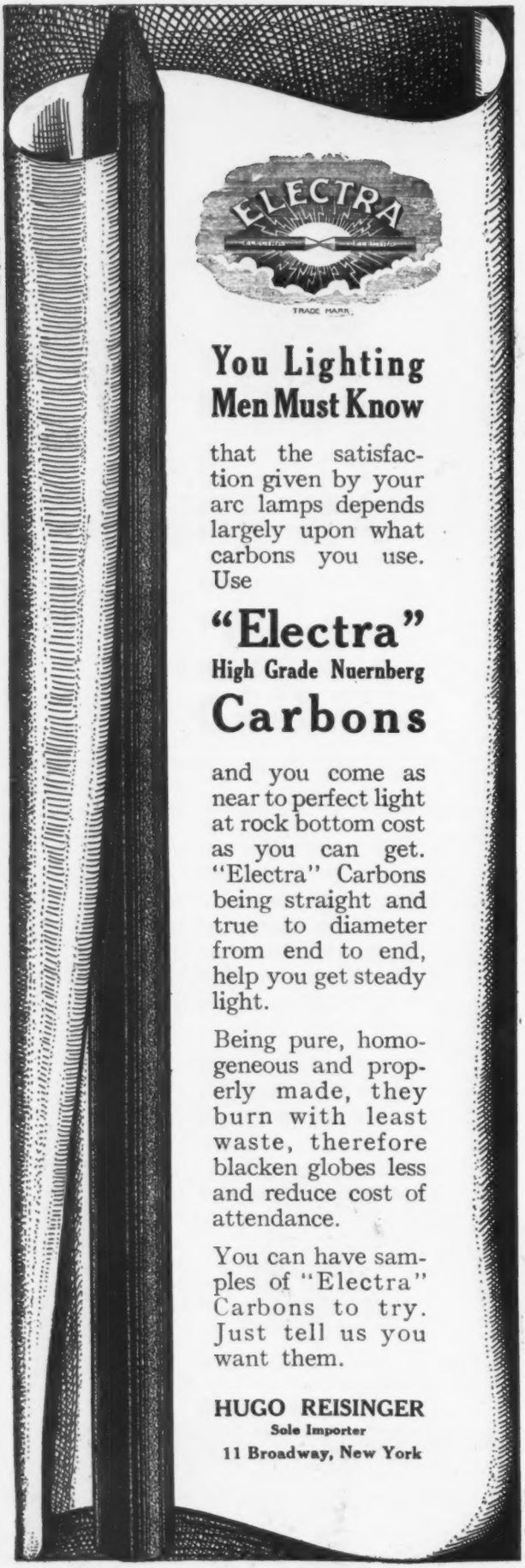
D.C. Starter with No-Voltage and Overload Release.



A.C. Polyphase Motor Starter, Drum Type.

THE CUTLER-HAMMER MFG. CO. MILWAUKEE

NEW YORK: Hudson Terminal (50 Church Street) CHICAGO: Monadnock Block PITTSBURG: Farmers' Bank Building
BOSTON: 176 Federal Street PHILADELPHIA: 1207 Commonwealth Trust Bldg. CLEVELAND: 1108 Schofield Bldg.
PACIFIC COAST AGENTS: Otis & Squires, 155 New Montgomery Street, SAN FRANCISCO



You Lighting Men Must Know

that the satisfaction given by your arc lamps depends largely upon what carbons you use. Use

"Electra"
High Grade Nuernberg
Carbons

and you come as near to perfect light at rock bottom cost as you can get. "Electra" Carbons being straight and true to diameter from end to end, help you get steady light.

Being pure, homogeneous and properly made, they burn with least waste, therefore blacken globes less and reduce cost of attendance.

You can have samples of "Electra" Carbons to try. Just tell us you want them.

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Sole Importer
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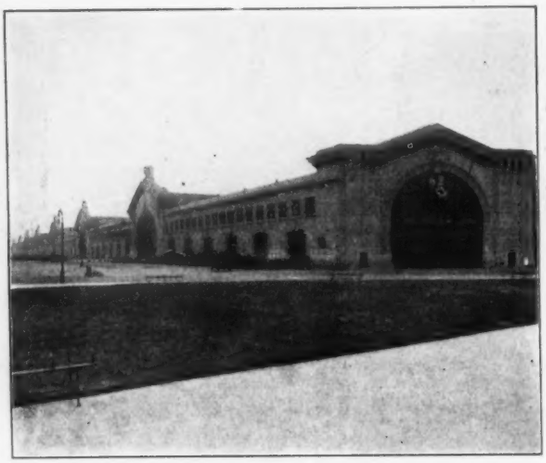
"The Glass Without the Glare"

The Wide Medium and Narrow Angle Reflectors offer a choice of form best suited to the most critical lighting problem.



CHELSEA PIERS, New York City
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1500 OPALUX REFLECTORS

Send for New Catalog Just Out.
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258 Broadway, New York

"EXCELLO"
will make a
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very soon
WAIT

THE EXCELLO ARC LAMP COMPANY

H. M. HIRSCHBERG, President
30-32 East 20th Street, New York

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FOX-MULTAX

THE FLAMING ARC LAMP

8400 C.P.
550 Watts

CENTURY 100 Burning Hours

TWO Years' Guarantee

LONG LIFE PLUS RELIABILITY

The one flaming arc that keeps maintenance cost minimized—by actually giving 100 burning hours—having no inner globes or gaskets to be replaced, and as easily trimmed as the ordinary open arc lamp.

There are no magazine or regenerative complications, clockwork, stops, rests or fragile carbons in the Fox-Multax Century.

Any electrician can install it.

Lamps for alternating (25 to 133 cycles) or direct current.

Two years' guarantee protects you against all maintenance cost above trimming labor and carbons.

Better investigate now.

THE FOX-MULTAX ELECTRIC CO., 126-130 Lafayette St., New York
Sales Offices in Principal Cities Throughout the World

FRINK'S Patent Portable Lamp Guard

Patented Aug. 22, 1905. No. 797,872

Made from Galvanized Bessemer Steel.

The Frink Standard Maintained Throughout.

Simple, Safe, Strong.

No Strain on Terminals of Socket

The Strongest Guard Made: Obstruction of Light the Least.

Easily Unlocked for Relamping, and Parts Will Not Loosen from Vibration.

Endorsed by Leading Railroad and Consulting Engineers

Frink's Patent Portable Lamp Guard

Including ½ inch base waterproof socket with reinforced set screw

No. 8072

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239, 241 and 243 10th Avenue, cor. 24th Street, New York
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Lord Beaconsfield once said to a member of the English Parliament: "I can give you

REASONS

but I cannot give you

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Mr. Jobber and Electrical Contractor you have

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"STAVE"

Flaming Arc Lamp is the very best on the market.

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It is the most perfect lamp on the market.

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Will stand rough handling without breakage or displacement of filament.

Has twice the life of a carbon lamp and gives a perfect white light without deterioration in quality. Saves 75 per cent. in current.

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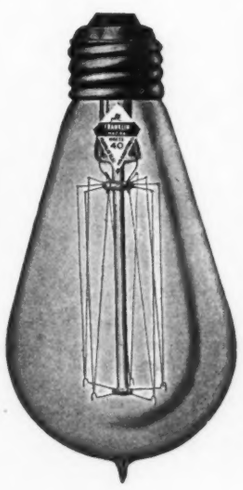


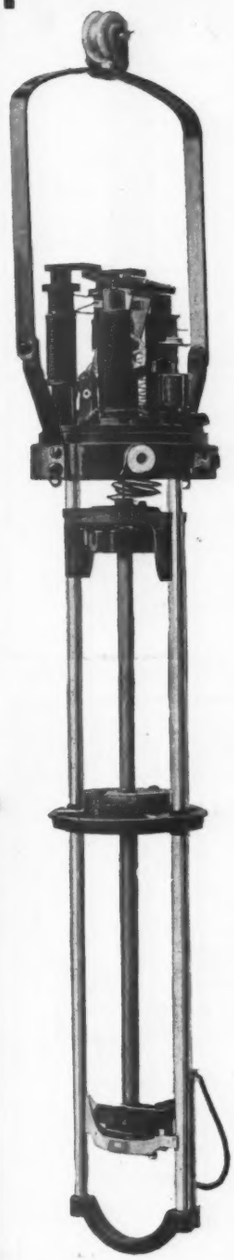
The "Franklin Mazda" Lamp

is always in advance of its competitors.

Notice the five filaments, the spring anchors and other improvements.

Let us tell you of them and quote you special prices on your requirements.

The JELLYFISH



is the simplest type of living creature. Nervous, alimentary, circulatory and muscular systems are inextricably mingled in one **crude, inefficient mess.** Something like the **simple (?)** arc lamps you hear so much about nowadays.

The human being derives his efficiency from the isolation of parts having different functions, away from disturbing outside influence.

In the "ALBA" FLAMING ARC LAMP the entire operating system is isolated in a dustproof compartment at the extreme top of the lamp. The chamber above the arc is entirely **free from clutches, magnets, slipper blocks, rocker arms or bell cranks,** which would be subjected to the corrosive arc fumes.

That is why it operates perfectly long after the simple (?) type of lamp is **choked and corroded into helplessness.**

The "ALBA" is as simple as a good lamp can be. Simplicity carried further only makes big repair bills.

ASK FOR "POINT BY POINT"

Charles L. Kiewert Co.

New York Chicago San Francisco
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The Modern Idea

in street lighting does away with large units 300 or 400 feet apart, and substitutes these

Corinthian Posts

set 75 to 90 feet apart. They give wonderful results when equipped with Tungsten burners.

Height from sidewalk to top of center globe, 14 ft., 7 in. Weight, 1,100 lbs.

Used exclusively in Milwaukee, Atlanta, Oklahoma City, Duluth, Jacksonville, Winnipeg, Minneapolis, Savannah and many other cities.

Write for booklets.

Flour City Ornamental Iron Works
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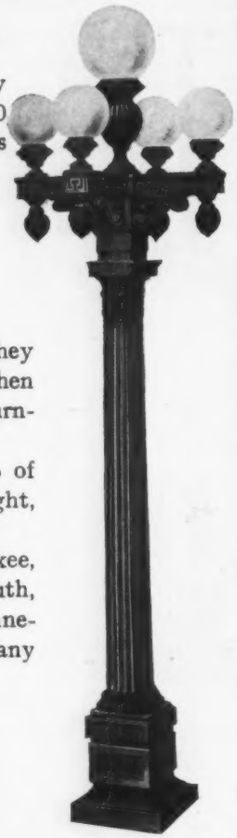

2

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For Street Lighting

ARC LAMP POLES, BRACKETS

Ornamental Lighting Posts for all purposes

We have just what you require among our thousand different models.

We manufacture all posts used for N. Y. City lighting.

Catalogues and special designs on application.

Correspondence solicited

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2046 J.

Put This Flaming Arc on a Series Enclosed Circuit

You can do it without altering or adding to the line wiring with an

A-B Regenerative Flaming Arc

That means greater leeway for Central Stations in Store and Display Lighting.

Full Seventy Hours Carbon Life.

Sturdy carbons that can be handled the same as ordinary carbons without breaking.

No Gears, weights or complicated mechanism

The A-B Regenerative Arc can be trimmed easily by even a one arm man.

Let us tell you all —Write

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Stop Trimming Arc Lamps

You can displace them in 15 minutes, and introduce a permanent saving by using

Cat. No. 0664½

Benjamin Mill Clusters

For 250-Watt Large Base Series Lamps

FIXTURES—Mill Clusters are of two kinds. No. 0664½ has a 24" enameled steel concentrating dome reflector and is intended for use where it is necessary to hang the lighting units sufficiently high to clear traveling cranes. No. 0684½ has a 24" enameled steel flat cone distributing reflector, for use where the units are suspended from 25 to 30 feet above the floor. Both fixtures have sockets for large base lamps, 8" stem of ½" iron pipe and shock absorber.

LAMPS—250-watt large base lamps (S-40-B) are used. They are burned either in series on 220-volt circuits or series multiple on 110-volt circuits. These lamps have a short and rugged filament, which is capable of withstanding ordinary jars and vibrations.

REFLECTED LIGHT VALUE, 1500 C. P.

RESULTS—(1) A superior quality of light; (2) 1500 C. P. of reflected light as compared with approximately 1300 C. P. of a flaming arc; (3) A reduction of from 25 to 30 per cent in operating expenses covering current renewals, and depreciation.

List price, less lamps, $16.50. Discounts on application.

BENJAMIN ELECTRIC MFG. CO., Chicago, 120-128 So. Sangamon St.
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SAMSON SPOT CORD

Every Consideration Points

to this thoroughly waterproofed honest cotton cord for hanging arc lamps. Better than any metallic suspension, because it won't short-circuit or break without warning, wears longer and costs less. 3

Samples?

SAMSON Cordage Works Boston, Mass.

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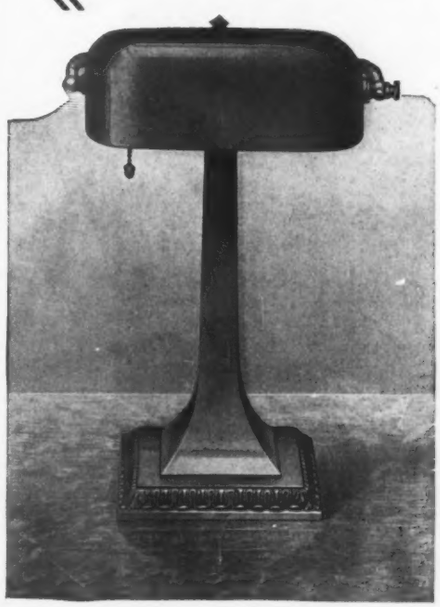
"KIND TO THE EYES"

"The proof of the pudding is in the eating." An ever-increasing volume of repeat orders from satisfied customers prove their unusual merit.



Green glass shade will not tarnish or collect dust; made in a large variety of patterns.

Send for interesting descriptive booklet.

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Our New "Highland" Line of Electric, Gas and Combination Fixtures

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These fixtures are winners and prices low. Line includes fixtures of all kinds, Tungsten fixtures, showers and brackets.

Write for illustrations and mention "Highland" Line.

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Yellow Flame

It pleases everybody, all the time, in every type of flaming lamp.

That is why it is so popular—why the orders are daily growing larger and more numerous.

The light is just what is required for absolute satisfaction—the life longest of all flaming carbons of this type.

Our prices will save you money.

If you want to "be shown" before placing your order, just say so and we will supply you with free samples.

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The G-M Lamp

(PATENT APPLIED FOR)

This is a really good library table reading lamp, designed to give service in every sense of the word.

If you read and value your eyes—write us.

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No. 09200 Gas

We manufacture a full line of Illuminating Glassware.

Prices and descriptive matter on application.

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Roughed **Bright Etched**
Opal **Alabaster**
Prismatic Reflectors
Licensed

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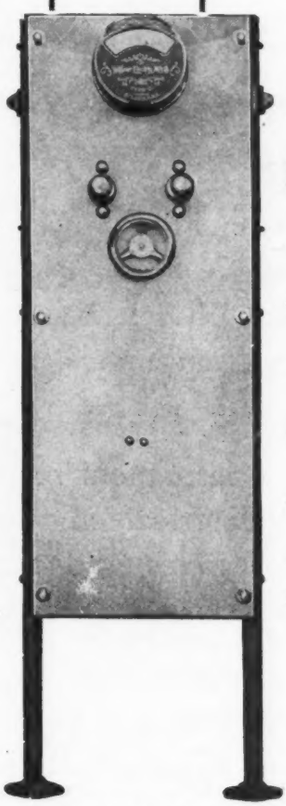
PHILADELPHIA

SHOWROOMS
Philadelphia New York Chicago Boston

3

THE "A-W" MAZDA SERIES CONTROL

is what you *need* for your Mazda street lamps.



Mark these points:

1. No moving parts.
2. High power factor.
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4. Ample protection.
5. Absolute reliability.
6. Lowest cost.

We can furnish the *entire* equipment, including street fixtures and lamps.

Get our figures before you decide.

(Patent applied for.)

—Sold by—

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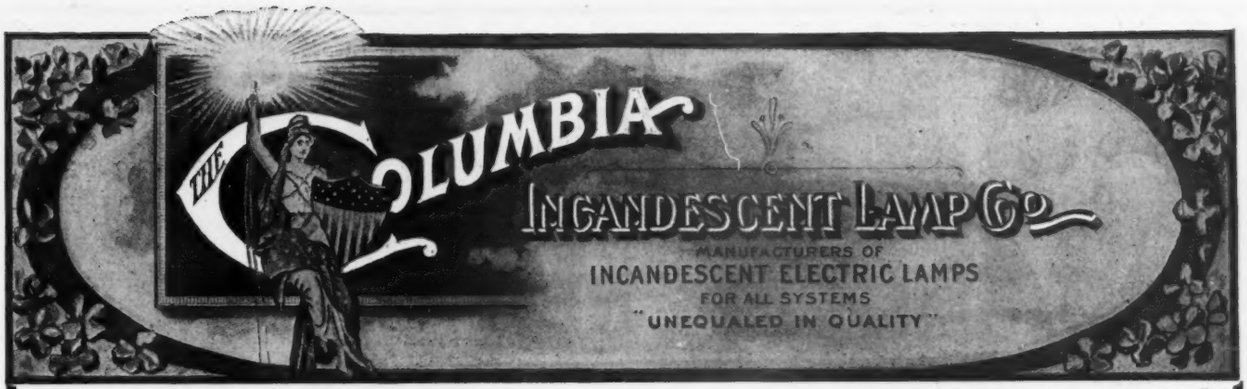

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For 40-watt Lamp. Fitter, 2¼"; height, 4½"; diameter, 5¾". 5 dozen in barrel.

give maximum diffusion and reflection. They are scientific, decorative and effective. Write for prices.

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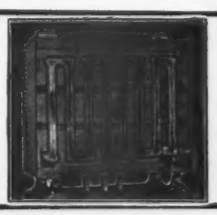

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THE MOORE LIGHT WINDOW is factory-built
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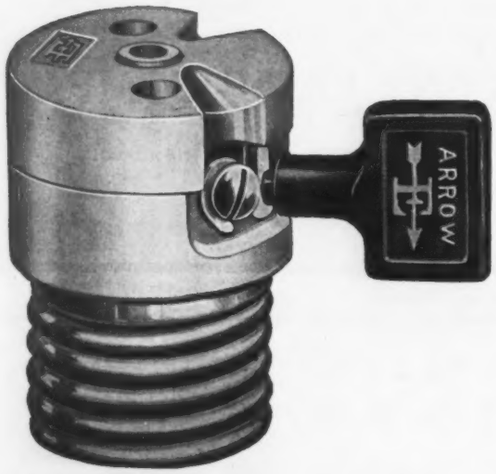

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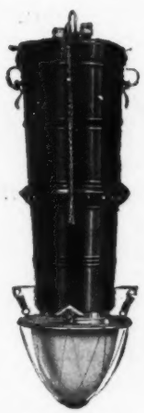

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Color of light: Golden yellow or white.

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The cord that you know so well

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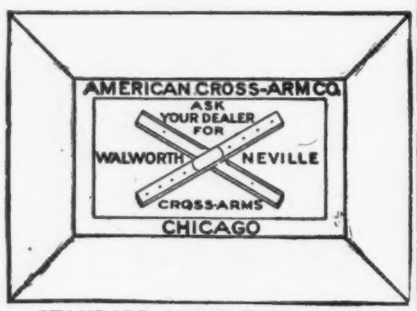

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For the Electrical Dealer, Contractor, Central-Station Operator and Consumer this distinctive scheme of

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The One Point of a Good Switch Is Service

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Embody QUALITY SERVICE Features

Every detail of electrical and mechanical construction in these small devices is the result of expert switch experience. Case hardened and tempered steel moving elements.

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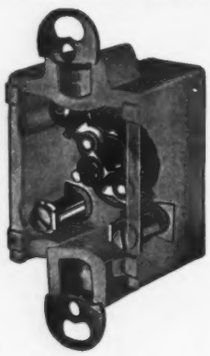

Sheet mica insulation. Substantial Porcelain Base with mechanism protected against the entrance of foreign matter. Wiring made easy by liberal apertures and long binding screws.

Every feature of ◇H◇ Switches makes for quality, durable quality, the quality that lasts.

The ◇H◇ Catalog illustrates and describes all kinds of Flush, Surface, Rotary Switches and Receptacles. It's yours for the asking. It's worth the asking. Write.

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If the Voltage Fails, the Motor is Disconnected From the Circuit

When starting a "Squirrel Cage" Induction Motor (7.5 h.p. or larger) a compensator should generally be used to prevent a heavy rush of current.

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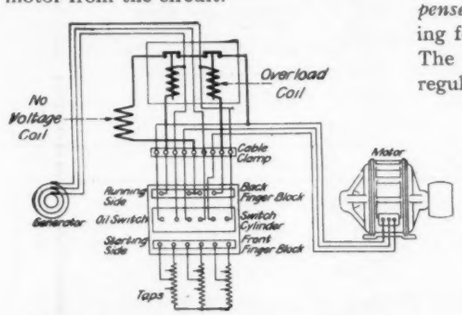
CR-117 Compensators

have no-voltage release and spring return switch

With these improved compensators, when the motor is started, a no-voltage release coil is energized. If the line voltage fails, the core of the coil drops and releases a latch which holds the switch in the running position. A strong spring causes the switch to return to the "off" position, disconnecting the motor from the circuit.



The simple connections of the no-voltage and overload release coils are shown by this circuit diagram. Note that the overload relays are in the running circuit only, and cannot be operated by the usual rush of current at starting. An adjustment can therefore be made for operation at but a slight rise above normal current.

Overload Relays

In place of the usual fuses, CR-11 Compensators can be equipped with overload relays which automatically cause the motor to be disconnected from the circuit, if the current exceeds a pre-determined value. Equipment is thus safeguarded against overloads *without any renewal expense*. Besides no time is lost waiting for new fuses after a shut down. The motor can be started in the regular way *immediately*.

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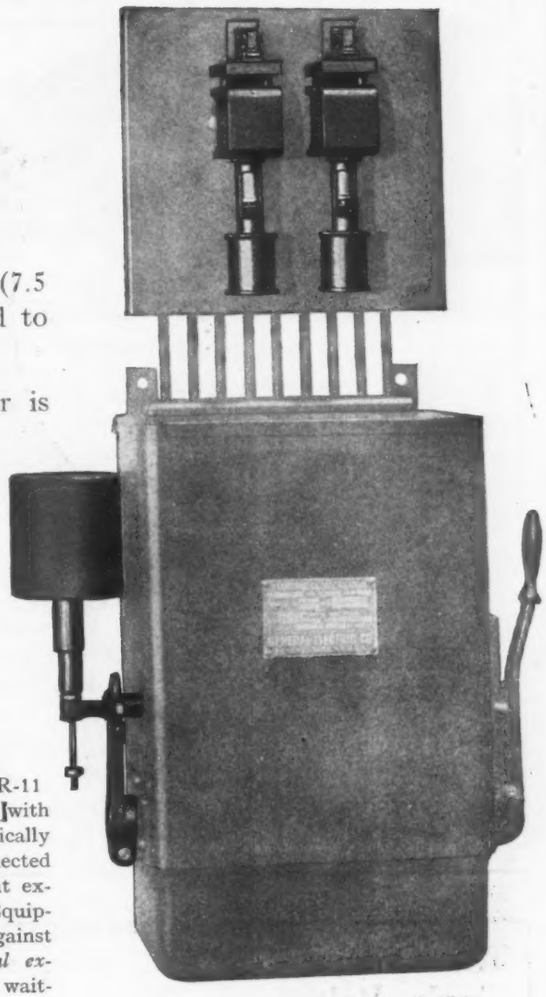
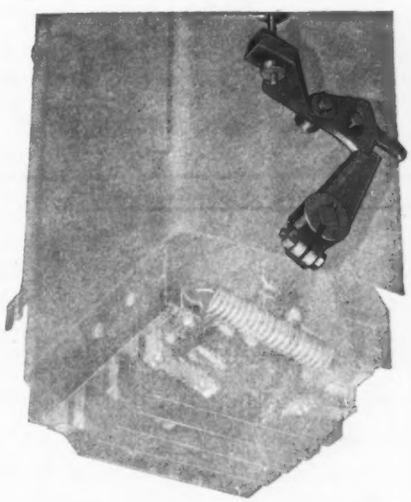
Bulletin 4771 explains and illustrates the novoltage and overload protection, how the switch must always be thrown *first* to the starting position, how the contacts are protected from injurious burning, how accessible is every part. A copy will be sent free on request. Address our nearest sales office.



The no-voltage release coil and latch are shown at the side of the Compensator. When ordered, relays are furnished instead of fuses, mounted on a slate base, as shown above.



This view shows how impact of the core of the novoltage release operates the tripping mechanism. A powerful spring insures the quick return of the switch to the neutral or "off" position.

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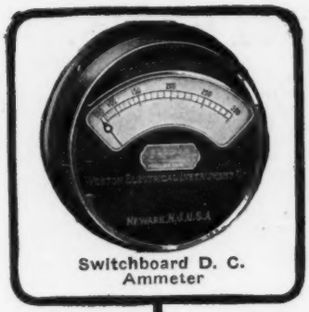
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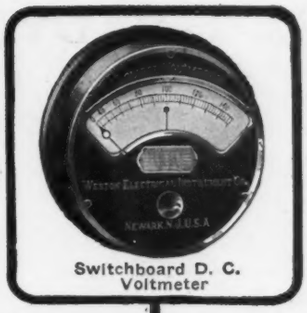
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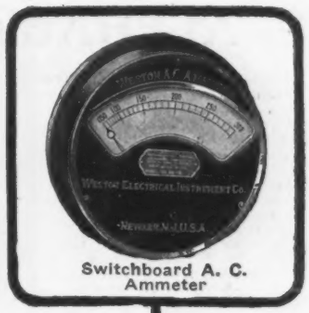
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Crocker-Wheeler Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Independent Elec. Mfg. Co.
Monitor Sales Dept.
Simplex Electric Heating Co.
Sundh Electric Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Conveying Machinery. (Coal, Ashes, Etc.)
Link-Belt Co.
Morse Chain Co.

Cooling Towers.
Alberger Condenser Co.

Cord Adjusters.
Matthews & Bro., W. N.

Cord, Arc Lamp.
American Vul. Fibre Co.
Samson Cordage Works.
Silver Lake Co.

Cord, Flexible.
American Electrical Works.
Belden Mfg. Co.
Sprague Electric Co.

Cord, Trolley.
Samson Cordage Works.

Crane Motors.
Crocker-Wheeler Co.
Sprague Electric Co.
Triumph Electric Co.
Western Electric Co
Westinghouse Elec. & Mfg. Co.

Cranes, Traveling.
Maris Bros.

Cross-Arms.
Berlin Mills Co.
Western Electric Co.
Wyckoff Pipe & Creosoting Co.

Cut-Outs.
D. & W. Fuse Co.
G. & W. Elec. Spec. Co.
Sears, Henry D.

Designers, Electric.
Sundh Electric Co.

Dials.
Manhattan Dial Co.

Divided Service Box.
Ricker Mfg. Co.

Drills.
Barnes Co., W. F. & Jno.

Drills, Brick.
Hubbard & Co.

Drills, Portable.
Stow Mfg. Co.

Drop Forgings.
Billings & Spencer Co.

Drying Machinery.
American Blower Co.
Buffalo Foundry & Mach. Co.
Devine Co., J. P.

Dynamos, Motors.
Allis-Chalmers Co.
Burke Elec. Co.
Century Electric Co.
Crocker-Wheeler Co.
Eck Dynamo & Motor Co.
Electric Machinery Co.
Electro-Dynamic Co.
Emerson Electric Mfg. Co.
Fort Wayne Electric Works.
Garwood Electric Co.
General Electric Co.
Gregory Electric Co.
Kimble Electric Co.
Lincoln Electric Co.
Mechanical Appliance Co.
Reliance Elec. & Eng'g Co.
Richmond Electric Co.
Ridgway Dynamo & Engine Co.
Robbins & Myers Co.
Roth Bros. & Co.
Siemens - Schuckertwerke-G.m.b.H.
Sprague Electric Co.
Stow Mfg. Co.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electric Locomotives.
Siemens - Schuckertwerke-G.m.b.H.

Electromagnets.
American Elec. Fuse Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Splitdorf, C. F.
Sundh Electric Co.

Elevators.
Link-Belt Co.

Engineers, Consulting.
(See Directory of Engineers.)

Engineers, Contracting.
(See Directory of Engineers.)

Engines, Gas and Gasoline.
Allis-Chalmers Co.
Carlisle & Finch Co.
Otto Gas Engine Wks.
Streiinger Co., Chas. A.
Struthers-Wells Co.
Turner-Fricke Mfg. Co.
Westinghouse Machine Co.

Engines, Oil.
Otto Gas Engine Wks.

Engines, Steam.
Allis-Chalmers Co.
American Blower Co.
Ball Engine Co.
Ball & Wood Co.
McIntosh, Seymour & Co.
Ridgway Dynamo & Engine Co.
Westinghouse Machine Co.

Experimental Apparatus.
Buffalo Foundry & Mach. Co.
Roller-Smith Co.

Fan Motors.
Century Electric Co.
Eck Dynamo & Motor Co.
Emerson Elec. Mfg. Co.
Fort Wayne Electric Works.
General Electric Co.
Peerless Electric Co.
Robbins & Myers Co.
Sprague Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Fans. (Exhaust and Ventilating.)
American Blower Co.
Century Electric Co.
Crocker-Wheeler Co.
Emerson Elec. Mfg. Co.
Green Fuel Economizer Co.
Mechanical Appliances Co.
Sprague Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Fibre. (See Insulating Material.)

Fibre Tubing.
American Vul. Fibre Co.
Fibre Conduit Co.

Field Coil Pads.
Massachusetts Chemical Co.

Filters, Oil.
Peterson Engineering Co.

Financial.
Coal & Iron National Bank.
Electric Bond & Share Co.
McGrath & Neuhausen Co.

Fixtures. (Gas and Electric.)
Benjamin Elec. Mfg. Co.
Central Electric Co.
Flour City Ornamental Iron Works.
Frink, I. P.
Goodwin & Kintz Co.
McFadden & Co., H. G.

Flanges, Welded.
Ball & Wood Co.

Flashers.
Campbell Electric Co.

Friction Tape and Cloths.
Johns-Manville Co., H. W.
Massachusetts Chemical Co.

Furnaces, Electric.
Hoskins Mfg. Co.

Fuses.
American Electric Fuse Co.
Condit Electrical Mfg. Co.
D. & W. Fuse Co.

CLASSIFIED INDEX—Continued.

Detroit Fuse & Mfg. Co.
Johns-Manville Co., H. W.
Sears, Henry D.

Fuse Boxes, A. C. Oil.
Johns-Manville Co., H. W.
Ricker Mfg. Co.

Gas Lighting Apparatus.
Ostrander & Co., W. R.
Splitdorf, C. F.

Gas Producers.
Struthers-Wells Co.

Gauges, Recording.
Bristol Co., The.

Gauges, Water Column.
Jenkins Bros.

Gears.
New Process Rawhide Co.

Generating Sets.
Allis-Chalmers Co.
Carlisle & Finch Co.
Triumph Electric Co.
Westinghouse Elec. & Mfg. Co.

Glass.
Gillinder & Sons, Inc.
Lippincott Glass Co.

Globes, Shades, Etc.
Gillinder & Sons, Inc.
Jefferson Glass Co.
Lippincott Glass Co.
McFadden & Co., H. G.
Opalux Co.

Graphite.
Acheson Graphite Co. (International).
Dixon Crucible Co., Joseph.

Grounds, Etc.
American Metal Works.

Guards, Inc. Lamp.
Frink, I. P.
Hubbell, Inc., Harvey.
Matthews & Bro., W. N.

Guy Clamps.
Matthews & Bro., W. N.

Hangers, Cable.
Conduit Electrical Mfg Co.
Standard Underground Cable Co.

Heaters, Feed Water.
Alberger Condenser Co.
Harrison Safety Boiler Works.

Heating and Ventilating Apparatus.
American Blower Co.
Green Fuel Economizer Co.

Heating Devices, Electric.
American Elec'l Heater Co.
Cutler-Hammer Mfg. Co.
Diamond Electric Co.
General Electric Co.
Hoskins Mfg. Co.
Pacific Elec. Heating Co.
Phelps Mfg. Co.
Shaler Co., C. A.
Simplex Electric Heating Co.
Sykes Mfg. Co., A. L.
Vulcan Electric Heating Co.
Westinghouse Elec. & Mfg. Co.

Heating, Steam.
American District Steam Co.

High-Speed Drills.
Cleveland Twist Drill Co.

Hoists, Electrical and Steam.
Allis-Chalmers Co.
Maris Bros.
Sprague Electric Co.

Hoists, Magnetic.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co

Hot Water Bottles, Electric.
Shaler Co., C. A.

Hydraulic Machinery.
Allis-Chalmers Co.
Pelton Water Wheel Co.

Ice Machines.
Carbondale Machine Co.

Igniters, Gas Engine.
Carlisle & Finch Co.

Indicators.
Excess Indicator Co.

Indicators, Flow.
Peterson Eng'g Co.

Indicators, Speed.
Roller-Smith Co.

Injectors.
Jenkins Bros.

Instruments, Electrical.
Graphic
Bristol Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Indicating.
Atwater Kent Mfg. Co.
Eldredge Elec. & Mfg. Co.
General Electric Co.
Hoyt Elec'l Instr. Works.
Keystone Elec'l Instr. Co.
Pignolet, L. M.
Roller-Smith Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec'l Instr. Co.
Integrating.
Columbia Meter Co.
Duncan Elec. Mfg. Co.
Fort Wayne Electric Works.
General Electric Co.
Sangamo Electric Co.
Westinghouse Electric & Mfg. Co.
Scientific and Testing.
J. G. Biddle.
Gurley, W. & L. E.
Leeds & Northrup Co.
Queen & Co., Ltd.

Insulating Cement.
Massachusetts Chemical Co.

Insulating Machinery.
Buffalo Foundry & Mach. Co.
New England Butt Co.

Insulating Material.
China and Porcelain.
Colonial Sign & Ins. Co.
General Bakelite Co.
Hartford Faience Co.
Hemming Mfg. Co.
Imperial Porcelain Works.
Locke Insulator Mfg. Co.
Ohio Brass Co.
Pittsburg High Voltage Ins. Co.
Star Porcelain Co.
Compounds, Paints and Varnishes.
Electric Cable Co.
General Bakelite Co.
Hemming Mfg. Co.
Massachusetts Chemical Co.
Mitchell-Rand Mfg. Co.
Ohio Brass Co.
Standard Varnish Works.
Sterling Varnish Co.
Composition, Cloth and Paper.
Anderson Mfg. Co., A. & J. M.
Massachusetts Chemical Co.
Fibre.
American Vul. Fibre Co.
Diamond State Fibre Co.
Lava.
Steward Mfg. Co., D. M.
Mica.
Munsell & Co., Eugene.
Staples.
Blake Signal & Mfg. Co.
Goldmark, James.
Tape.
American Electrical Works.
Massachusetts Chemical Co.
New York Insulated Wire Co.
Standard Underground Cable Co.
Transmission.
Western Engineering Spec. Co.

Insulator Clamps.
Clark Electric & Mfg. Co.

Insulators, China, Porcelain and Composition.
Anderson Mfg. Co., A. & J. M.
Central Electric Co.
Clark Elec. & Mfg. Co.
Colonial Sign & Ins. Co.
Dickinson Mfg. Co.
General Electric Co.
Imperial Porcelain Works.
Johns-Manville Co., H. W.
Locke Insulator Mfg. Co.
Ohio Brass Co.
Pittsburg High Voltage Ins. Co.
Sears, Henry D.
Star Porcelain Co.
Western Electric Co.

Insulators, Glass.
Brookfield Glass Co.
Hemingray Glass Co.
Locke Insulator Mfg. Co.
Ohio Brass Co.

Insulators, Transmission.
Western Eng'g Specialties Co.

Jacks.
Watson-Stillman Co.

Joints, Expansion.
Alberger Condenser Co.

Lamp Changers or Replacers.
Matthews & Bro., W. N.

Lamps, Arc.
Adams-Bagnall Elec. Co.
Anderson Mfg. Co., A. & J. M.
Excello Arc Lamp Co.
Fort Wayne Electric Works.
General Electric Co.
Kiewert Co., Chas. L.
Queen & Co., Inc.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Desk.
Electric Motor & Equip. Co.
McFaddin & Co., H. G.

Lamps, Flaming Arc.
Excello Arc Lamp Co.
Fox-Muitax Elec. Co.
Kiewert Co., Chas. L.
Stave Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Lamps, Incandescent.
Boston Inc. Lamp Co.
Central Electric Co.
Columbia Inc. Lamp Co.
General Electric Co.
Heany Lamp Co.
Metropolitan Elec'l Supply Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Lamps, Miniature.
General Electric Co.

Lamps, Vacuum Tube.
Moore Light Co.

Lathes.
Barnes Co., W. F. & Jno.

Lava. (See Insulating Material, Lava.)

Lighting Companies.
Commonwealth Edison Co.

Lightning Arresters.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Line Material.
Anderson Mfg. Co., A. & J. M.
Archbold-Brady Co.
Clark Electric & Mfg. Co.
G. & W. Elec. Spec. Co.
Johns-Manville Co., H. W.
Ohio Brass Co.
Stromberg-Carlson Tel. Mfg. Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Lubricants.
Acheson Graphite Co. (International.)
Dearborn Drug & Chemical Works.
Dixon Crucible Co., Jos.
Kellogg Co., E. H.

Lubricators, Force Feed.
Peterson Engineering Co.

Lumber.
Wyckoff Pipe & Creosoting Co.

Machine Tools.
Garvin Machine Co.

Machinery, Grinding.
Geometric Tool Co.

Magnets.
Leslie & Co., Ltd., A. C.

Magnets, Steel.
Leslie & Co., Ltd., A. C.

Magnet, Wire.
American Electric Fuse Co.
Belden Mfg. Co.
Benedict & Burnham Mfg. Co.
D. & W. Fuse Co.
Massachusetts Elec. & Mfg. Co.
Riege, Archer C.

Magnets, Lifting.
Cutler-Hammer Mfg. Co.
Standard Underground Cable Co.
Stromberg-Carlson Tel. Mfg. Co.
Western Electric Co.

Mechanical Draft.
American Blower Co.
Green Fuel Economizer Co.

Mechanical Stokers.
Green Engineering Co.
Westinghouse Machine Co.

Medical Apparatus.
Manhattan Elec'l Supply Co.
Pignolet, Louis M.
Splitdorf, C. F.

Metals.
American Platinum Works.
Baker & Co., Inc.
Phosphor-Bronze Smelting Co.

Metal Polish.
Hoffman, George W.

Meter Testers.
Blakeslee, H. J.

Mica.
Jaroslaw, D.
Meirowsky Bros.
Munsell & Co., Eugene.

Mining Machinery.
Allis-Chalmers Co.
Crocker-Wheeler Co.
General Electric Co.

Motors. (See Dynamos and Motors.)

Nippers and Pliers.
Cincinnati Tool Co.

Novelties, Electric.
Carlisle & Finch Co.

Oil, Cylinder. (See Lubricants.)

Oiling Systems.
Peterson Engineering Co.

Packing.
Jenkins Bros.
Johns-Manville Co., H. W.
Peerless Rubber Mfg. Co.

Panel Boards.
Trumbull Electric Mfg. Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Phosphor Bronze.
Phosphor Bronze Smelting Co.

Photometer Standards.
Electrical Testing Laboratories.

Pinions, Rawhide.
New Process Rawhide Company.

Pipe and Boiler Coverings.
Johns-Manville Co., H. W.

Platinum.
American Platinum Works.
Baker & Co., Inc.
Roessler & Hasslacher Chemical Co.

Plugs.
Condit Electrical Mfg. Co.
Hubbell, Inc., Harvey.
Paiste Co., H. T.
Sears, Henry D.

Pole Line Hardware.
Hubbard & Co.

Poles, Brackets, Pins, Etc.
Berlin Mills Co.
Page & Hill Co.
Sand Point Lumber & Pole Co., Ltd.
Sterling & Son Co., W. C.
Western Electric Co.
Western Lumber & Pole Co.
Wyckoff Pipe & Cresoting Co.

Poles, Arc Lamp.
Flour City Ornamental Iron Works.
Mott Iron Works, J. L.

Poles, Steel.
Franklin Steel Co.

Porcelain. (See Insulating Material, China and Porcelain.)

Potentiometers.
Biddle, J. G.
Leeds & Northrup Co.

Potheads.
Colonial Sign & Ins. Co.
G. & W. Elec. Spec. Co.

Power Transmission Machinery.
Link Belt Co.
Morse Chain Co.

Presses, Dies & Special Machinery.
Watson-Stillman Co.

Producers.
Westinghouse Machine Co.

Pulleys.
Rockwood Mfg. Co.

Pumps, Air.
Goulds Mfg. Co.

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Pumps, Centrifugal.
Alberger Pump Co.
Allis-Chalmers Co.

Pumps, Electric.
Goulds Mfg. Co.

Pumps, Oil.
Ludlow Valve Mfg. Co.

Pumps, Steam.
Alberger Condenser Co.
Alberger Pump Co.
Allis-Chalmers Co.
Deming Co.
Heisler Co.

Pumps, Vacuum.
Alberger Condenser Co.
Goulds Mfg. Co.

Purifiers, Feed Water.
Harrison Safety Boiler Works.

Push Buttons.
Manhattan Electrical Supply Co.

Rail Bonds.
Clark Electric & Mfg. Co.
Condit Electrical Mfg. Co.
Roebling's Sons Co., J. A.

Railway Motors.
Siemens - Schuckertwerke-G. m. b. H.

Railways, Miniature.
Carlisle & Finch Co.

Receptacles. (See Sockets.)

Rectifiers.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Reflectors.
Frink, I. P.
Goodwin & Kintz.
Jefferson Glass Co.
Opalux Co.

Refrigerating Machines.
Carbondale Machine Co.

Repairing.
Commonwealth Edison Co.
Gregory Electric Co.
Westinghouse Electric & Mfg. Co.

Resistance Units.
Cutler-Hammer Mfg. Co.
Independent Elec. Mfg. Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.

Resistance, Wire.
American Elec. Fuse Co.
Belden Mfg. Co.
Driver-Harris Wire Co.

Rheostats.
Allen-Bradley Co.
American Elec. Fuse Co.
Campbell Electric Co.
Crocker-Wheeler Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Independent Elec. Mfg. Co.
Simplex Electric Heating Co.
Sundh Electric Co.
Ward Leonard Electric Co.
Westinghouse Electric & Mfg. Co.

Rosettes.
Hart Mfg. Co.
Paiste Co., H. T.
Sears, Henry D.
Trumbull Electric Mfg. Co.

Sal Ammoniac.
Roessler & Hasslacher Chemical Co.

Searchlights.
Carlisle & Finch Co.

Second-Hand Apparatus.
Duzets & Sons.
Gregory Electric Co.
Jordan Bros.
MacGovern, Archer & Co.
National Machinery & Wrecking Co.
Power Equipment Co.

Separators. (Oil and Steam.)
Harrison Safety Boiler Works.

Shade Holders.
Hubbell, Inc., Harvey.

Shades.
Frink, I. P.
Gillinder & Sons, Inc.
Hubbell, Inc., Harvey.
Jefferson Glass Co.
Lippincott Glass Co.
McFaddin & Co., H. G.
Opalux Co.

Shafts, Flexible.
Stow Mfg. Co.

Sheet Metal.
American Sheet & Tin Plate Co.

Sheets, Electrical.
American Sheet & Tin Plate Co.
Follansbee Bros. & Co.

Shows, Elec'l.
Electrical Exhibition Co.

Signs, Electric.
Colonial Sign & Ins. Co.
Electric Motor & Equip. Co.
Flexlume Sign Co.
Frink, I. P.

Sign Letters.
Colonial Sign & Ins. Co.
Electric Motor & Equip. Co.

Sleeving, Braided.
Belden Mfg. Co.

Sockets & Receptacles.
Arrow Electric Co.
Benjamin Electric Mfg. Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hubbell, Inc., Harvey.
Johns-Manville Co., H. W.
Paiste Co., H. T.
Sears, Henry D.

Solder.
Belden Mfg. Co.

Soldering Flux.
Blake Signal & Mfg. Co.
Condit Electrical Mfg. Co.

Soldering Irons.
Diamond Electric Co.
Hoskins Mfg. Co.
Simplex Electric Heating Co.
Vulcan Electric Heating Co.

Solenoids.
American Elec. Fuse Co.
Cutler-Hammer Mfg. Co.
Independent Elec. Mfg. Co.
Sundh Electric Co.
Ward Leonard Electric Co.

Splicing Compound.
Massachusetts Chemical Co.

Springs.
Barnes Co., The Wallace.
Cary Spring Wks.

Stage-Lighting Apparatus.
Campbell Electric Co.
Condit Electrical Mfg. Co.
Frink, I. P.
Johns-Manville Co., H. W.

Staples. (See Insulating Materials, Staples.)

Starters.
Allen-Bradley Co.
General Electric Co.

Steel.
American Bridge Co.
Leslie & Co., Ltd., A. C.

Stoves, Electric.
Cutler-Hammer Mfg. Co.
Diamond Electric Co.
Hoskins Mfg. Co.

Supplies. (Electric Railway.)
Anderson Mfg. Co., A. & J. M.
Johns-Manville Co., H. W.
Ohio Brass Co.
Western Electric Co.

Supplies. (General Electrical.)
Central Electric Co.
Manhattan Electrical Supply Co.
Montgomery & Co.
Ostrander & Co., W. R.
Western Electric Co.

Supplies, Telephone.
Stromberg-Carlson Tel. Mfg. Co.
Western Electric Co.

Switchboard Mats.
Massachusetts Chemical Co.

Switchboard Supplies.
Condit Electric Mfg. Co.
Roller-Smith Co.
Westinghouse Electric & Mfg. Co.

Switchboards.
Allis-Chalmers Co.
Anderson Mfg. Co., A. & J. M.
Central Electric Co.
Condit Electrical Mfg. Co.
General Electric Co.
Roller-Smith Co.
Stromberg-Carlson Tel. Mfg. Co.
Triumph Electric Co.
Trumbull Electric Mfg. Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Switchboards, Telephone.
Stromberg-Carlson Tel. Mfg. Co.
Western Electric Co.

Switches.
Arrow Electric Co.
Cutler-Hammer Mfg. Co.
Sundh Electric Co.
Westinghouse Electric & Mfg. Co.

Switches, Knife.
Anderson Mfg. Co., A. & J. M.
Condit Electrical Mfg. Co.
Cutter Co.
Detroit Fuse & Mfg. Co.
Trumbull Electric Mfg. Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Switches, Oil.
Condit Electrical Mfg. Co.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Switches, Snap.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hart Mfg. Co.

Switches, Time.
Campbell Electric Co.

Tachometers.
Biddle, J. G.
Queen & Co., Inc.
Roller-Smith Co.

Taps and Dies.
Carpenter Tap & Die Co., J. M.

Telephones.
Manhattan Electrical Supply Co.
Stromberg-Carlson Tel. Mfg. Co.
Western Electric Co.

Testing Apparatus.
Biddle, J. G.
Gurley, W. & L. E.
Leeds & Northrup Co.
Queen & Co., Inc.
Roller-Smith Co.

Testing, Electrical.
Electrical Testing Laboratories.

Testing Laboratories.
Electrical Testing Laboratories.

Theatre Dimmers.
Cutler-Hammer Mfg. Co.
General Electric Co.
Independent Elec. Mfg. Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.

Thermometers.
Leeds & Northrup Co.
Queen & Co., Inc.

Tools, Construction.
Cincinnati Tool Co.
Klein & Son, Mathias.
Montgomery & Co.

Tools, Linemen's.
Cincinnati Tool Co.
Klein & Son, Mathias.

Towers, Transmission.
Archbold-Brady Co.

Transformers.
Allis-Chalmers Co.
Campbell Electric Co.
Central Electric Co.
Crocker-Wheeler Co.
Duncan Elec. Mfg. Co.
Enterprise Electric Mfg. Co.
Fort Wayne Electric Works.
General Electric Co.
Kuhlman Electric Co.
Moloney Electric Co.
Packard Electric Co.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Transformers, Bell Ringing.
Westinghouse Elec. & Mfg. Co.

Tube Cleaners.
Liberty Mfg. Co.

Turbines, Steam.
Allis-Chalmers Co.
Ball & Wood Co.
General Electric Co.
Western Electric Co.
Westinghouse Machine Co.

Turbines, Water.
(See Hydraulic Machinery.)

Vacuum Drying and Impregnating Apparatus.
Buffalo Fdy. & Machine Co.
Devine Co., J. P.

Valve Discs.
Jenkins Bros.

Valves.
Jenkins Bros.
Pittsburgh Valve Fdy & Const. Co.
Sundh Electric Co.

Valves, Cylinder Relief.
Ludlow Valve Mfg. Co.

Valves, Pump.
Jenkins Bros.

Washing Machines, Electric.
Automatic Electric Washer Co.

Waterproofing.
Mitchell-Rand Mfg. Co.

Water Purifying System.
Harrison Safety Boiler Works.

Water Wheels and Turbines.
Allis-Chalmers Co.
Dayton Globe Iron Works.
Leffel & Co., James.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Trump Mfg. Co.

Water Wheel Governors.
Lombard Governor Co.
Ludlow Valve Mfg. Co.
Woodward Governor Co.

Wattmeters, Watt-hour Meters.
(See Instruments, Electrical.)

Winding Machinery.
New England Butt Co.

Wires, Resistance.
Belden Mfg. Co.
Driver-Harris Wire Co.

Wires and Cables.
American Electrical Works.
American Steel & Wire Co.
Atlantic Ins. Wire & Cable Co.
Bay State Ins. Wire & Cable Co.
Belden Mfg. Co.
Benedict & Burnham Mfg. Co.
Bridgeport Brass Co.
Central Electric Co.
Chicago Ins. Wire & Mfg. Co.
D. & W. Fuse Co.
Detroit Ins. Wire Co.
Diamond Rubber Co.
Driver-Harris Wire Co.
Electric Cable Co.
General Electric Co.
Habirshaw Wire Co.
Hazard Mfg. Co.
Heany Fireproof Wire Co.
Indiana Rubber & Ins. Wire Co.
Kerite Ins. Wire & Cable Co.
Lowell Ins. Wire Co.
Massachusetts Electric Mfg. Co.
Metropolitan Elec'l Supply Co.
Moore, A. F.
National Conduit & Cable Co.
National India Rubber Co.
New York Insulated Wire Co.
Phillips Insulated Wire Co.
Phosphor-Bronze Smelting Co.
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Simplex Electrical Co.
Standard Underground Cable Co.
Stromberg-Carlson Tel. Mfg. Co.
Waclark Wire Co.
Waterbury Co.
Western Electric Co.

Wood Preserving.
Wyckoff Pipe & Creosoting Co.

Wrenches.
Billings & Spencer Co.

X-Ray Apparatus.
Campbell Electric Co.

Directory of Engineers

ARNOLD CO., THE
Engineers, Constructors
Electrical—Civil—Mechanical
181 La Salle Street, Chicago

BARSTOW & CO., W. S.
(Incorporated)
Engineers
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1	60	National, 3-phase, revolving field, 6600 v.	1200
1	65	Stanley, 2-phase, inductor type	900
1	75	Stanley, 2-phase, inductor type	900
1	75	Westinghouse, 2-phase, distributed winding	720
1	90	Gen. Elec., type A. S., single phase	900
1	90	Elec. Mach. Co., 3-phase, revolving field	720
1	100	National, 3-phase, revolving field, 6600 v.	900
2	100	Gen. Elec., type A.T.B., 3-phase	900
3	150	Westinghouse, single phase.	600
1	150	Ft. Wayne, single phase, 3-bearing	450
1	175	Stanley, 2-phase, inductor type	514
1	180	Westinghouse, 2-phase	514
1	180	Westinghouse, 3-phase	415
3	200	Gen. Elec., 3-phase, rev. field	600
1	300	Gen. Elec., revolving field, 3-bearing, single phase	450

25-Cycle Alternators

KVA.			Speed.
1	275	Westinghouse, 3-phase, revolving field, 6600 v., with exciter	350
1	400	Westinghouse, 3-phase, 440 v., rev. armature type, 3-bearing	300

125-133 Cycle Alternators

KVA.			Speed.
1	30	National, 1100 volts	1500
1	30	Gen. Elec., type A30, 1100 v.	1500
1	30	Gen. Elec., type AS30, 1100 volts	1500
1	60	Ft. Wayne, 1100 v.	1400
2	60	Westinghouse, 1100 or 2200 volts	1650
1	60	Gen. Elec., A60, 1100 volts.	1500
2	60	Gen. Elec., type AS60, 1100 volts	1500
1	60	Westinghouse, 1100 volts.	1333
2	75	Ft. Wayne, comp., 1100 or 2200 volts	1050
1	90	Ft. Wayne, 1100 volts	1050
3	90	Gen. Elec., type A.S.. 1100 or 2200 volts	1250
1	100	Ft. Wayne, type W. A. L., 1100 or 2200 volts	1050

500-Volt Comp. Generators

KW.			Speed.
1	25	Triumph, MP, comp.	950
2	30	Northern, MP, comp.	750
1	35	Northern, MP, comp.	725
1	40	National, 6-pole, comp.	600
1	100	Gen. Elec., 6-pole, comp., form H	600
1	150	Northern, MP, comp., 6-pole	625
1	200	Westinghouse, 6-pole, comp.	510
1	250	Westinghouse, 6-pole, comp.	450

125-Volt D. C. Dynamos

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Lights.			Speed.
1	110	Western Elec., 6 KW	1860
1	120	Peerless, 7½ KW	1250
1	135	Fairbanks-Morse, 7½ KW	1600
2	150	Cincinnati, 8½ KW	1100
	150	Gibbs, 9 KW	900
1	150	Western Elec	1100
1	150	C. & C., 9 KW	950
1	150	Western Elec., 9 KW	800
1	180	Amer. Eng. Co., 10 KW	1350
1	180	Ideal, 10 KW	1200
1	180	Northern, 10 KW	800
1	200	Commercial, 12 KW	1300
1	200	Crocker-Wheeler, 11½ KW.	1250
1	210	Robbins & Myers, 12 KW.	1200
1	210	Western Elec., 12 KW	1600
1	210	Sprague, 12½ KW	1550
1	210	Sturtevant, 12½ KW	1000
1	210	C. & C., 12 KW	900
1	210	Gibbs, 12 KW	750
2	250	National, 15 KW, new	1700
1	270	Northern, 15 KW	1125
1	300	Ft. Wayne, 17½ KW	1000
3	300	Crocker-Wheeler, 18 KW.	875
1	350	Ft. Wayne, 20 KW	1200
2	400	Western Elec., MP, 22½ KW.	900
2	400	Crocker-Wheeler, MP, 22½ KW.	850
1	450	Fairbanks-Morse, MP, 25 KW.	825
1	450	Gen. Elec., 25 KW.	970
1	600	Triumph, MP, 35 KW.	875
1	1300	Card, MP, 75 KW.	500
1	1800	Eddy, MP, 100 KW.	650
1	1800	Gen. Elec., 6-pole, 100 KW.	600
1	1800	Gen. Elec., 100 KW, 3-wire unit, Lake Erie Vertical Engine, directly con. to two 50 KW Gen. Elec., comp., 125 volts generators	275
1	1800	Westinghouse, MP, comp., 100 KW, direct con. to 15½ x 15 Ideal latest type engine	250
1	2500	Western Electric, 150 KW, 8-pole, new, comp., direct connected to cross-comp. Ball & Wood engine	250

250-Volt Generators

KW.			Speed.
1	20	Commercial, MP, comp.	1100
1	20	Commercial, MP, comp.	750
1	25	Northern, MP, comp.	600
1	25	Westinghouse, MP, type S, comp.	650
1	30	Elec. Mach. Co., MP, comp.	950
1	30	Commercial, MP, comp.	600
1	30	Northern, MP, comp.	675
1	30	Ideal, MP, type D, comp., new	600
3	30	Gen. Elec., type C.L6, comp.	700
1	35	C. & C., comp., type M.P.L.	750
1	35	Sprague, 6-pole, type S. L., comp.	950
2	35	West. Elec., MP, comp.	500
1	42½	Allis-Chalmers, MP, comp..	950
1	45	Northern, MP, comp.	900
1	50	Ft. Wayne, MP, comp.	600
1	60	Triumph, MP, comp., 6-pole.	800
1	100	Gen. Elec., 3-wire unit, Lake Erie, cross-comp., vertical engine, direct connected to two 50 KW Gen. Elec. comp., 125-volt generators	275
1	100	Jenney, 6-pole, comp., direct connected to Allfree center-crank, auto, self-oiling engine	250

500-Volt D. C. Motors

H.P.			Speed.
1	1	Northern, MP	1550
10	1	Gen. Elec., type C.A.	1300
1	1	Peerless, MP	1000
1	1	Peerless, MP	655
1	1	Gen. Elec., type C. A.	1000
1	2	Roth Bros., MP.	1850
2	2	Gen. Elec., type C. A.	2000
1	2	Lundell	1000
1	2	Peerless, MP, back-geared.	1050-210
5	2	Gen. Elec., type C. E.	1200
1	2	Westinghouse, MP.	1200
1	2½	Peerless, MP, back-geared.	1660-332
1	2½	Peerless, MP.	445
1	3	Peerless, MP.	1515
1	3	Browning	1680
1	3	Hobart, MP.	1000
6	3	Gen. Elec., type C. E.	1800
1	3	Crocker-Wheeler, MP, comp.	1140
2	3	Gen. Elec., type C.E.	1200
1	3½	Roth, MP.	1600
1	3½	Peerless, MP, back-geared.	915-183
2	5	Gen. Elec., type C. E.	1800
1	5	Browning	1200
1	5	Commercial, round frame	1200
2	5	Peerless, MP.	1225
1	5	Peerless, MP, back-geared.	1100-220
1	5	Sprague-Lundell	1040
1	5	Gen. Elec., type C. Q.	1350
5	5	Gen. Elec., type C. E.	1200
1	5	Crocker-Wheeler, MP.	1050
1	5	Westinghouse, MP.	950
2	5½	Westinghouse, MP.	1600
1	7½	Bernard, MP, series.	1200
1	7½	Gen. Elec., type C. E.	1650
1	7½	Western Elec., MP, comp.	660
1	7½	Gen. Elec., MP.	1000
1	7½	Sprague-Lundell	700
1	9	Gen. Elec., MP.	400
1	10	Western Elec., MP.	1440
1	10	C. & C. multipolar.	1350
2	10	National, MP, new.	1650
1	10	Jenney, MP.	950
1	10	Westinghouse, MP.	1200
1	10	Northern, MP.	775
2	10	Gen. Elec., MP.	800
1	12	Amer. Eng. Co., MP.	1200
1	15	Commercial, MP.	1200
1	15	Paragon, MP.	1200
1	15	Triumph, MP.	1100
2	15	Westinghouse, MP.	1150
4	15	Peerless, MP.	600
6	15	Gen. Elec., MP.	1200
3	15	Gen. Elec., MP, comp.	750
1	20	Commercial, MP.	1000
1	20	Westinghouse, MP.	1000
1	20	Westinghouse, MP.	650
1	22	Milwaukee, MP.	1150
1	25	Colonial, MP.	785
1	25	Gen. Elec., MP.	535
1	30	Milwaukee, MP.	1075
1	30	Phoenix, MP.	650
1	30	Triumph, MP, comp.	830
1	30	Gen. Elec., MP, form A.	625
1	35	Northern, MP.	725
2	35	Northern, MP, comp.	625
1	35	Gen. Elec., MP, form H.	975
1	40	Willey, MP.	800
1	40	Gen. Elec., type comp.	1100
1	40	Northern, MP, comp.	625
1	50	Gen. Elec., MP.	900
1	50	National, 6-pole.	450
1	50	Gen. Elec., MP.	550
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1— 30 HP. Westinghouse "CCL," 200 volts, 840 RPM.
1— 20 HP. General Electric "K," 220 volts, 900 RPM.

60 cycle, 2 phase

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2— 75 HP. General Electric "M," 200 volts, 450 RPM.
1— 55 HP. General Electric "K," 200 volts, 514 RPM.
1— 40 HP. Westinghouse "CCL," 200 volts, 840 RPM.
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ELECTRICAL ENGINEER—Conversant with every detail of new business-getting methods, wants to make a change of position; references unexcelled as to ability, character, etc. Address W. J. MARLAND, 305 Claus Spreckels Bldg., San Francisco, Cal.

NEW BUSINESS manager, 5 years' experience, wants position with electric or combination company; at present with one of the largest corporations in the country; best of high grade references; could take charge on short notice. Address A. B. Z., 8021, care Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

MANAGER—Now in charge of combination light, water and ice plant desires change, well versed in the above lines, having both technical and practical experience; highest references; married can handle men and produce results; South or Southwest location desired. Address No. 7896, care of Electrical World, New York.

INCANDESCENT lamp expert; 31 years old; can manufacture all types of lamps, including metallic filaments; held executive position in large European factory for four years; employed in a local metallic filament factory for the past year, but wishes to change position. Address No. 7970, care of Electrical World, New York.

ELECTRICAL engineer; technical graduate; with four years' experience in designing, operating and construction work, desires a position in the West, either with an engineering firm or with an operating company. Address No. 7997, care of Electrical World, New York.

EXPERIENCED manager, thoroughly acquainted with the electrical trade, and at present manager of one of the largest institutions of its kind in Canada, contemplates a change January 1. Will entertain proposition for Canadian or States management of branch office for reliable firm. Address No. 7995, care of Electrical World, New York.

ELECTRICAL ENGINEER; 7 years in engineering dept. of large operating company; 1 year in maintenance dept. of large manufacturing company, both in New York; experience covers building construction and equipment, also installation and maintenance of power plant and factory equipment; position in New York preferred. Address No. 7890, care Electrical World, New York.

SALES engineer, now employed, open for engagement; five years' central station experience; specializing development of motor load; expert on examinations and reports; am good executive, organizer and thorough mixer; those having use for a hustler and result-getter communicate with No. 7975, care of Electrical World, New York.

SUPERINTENDENT OF CONSTRUCTION with large construction company; technical graduate; electrical and civil; varied experience in engineering construction and operation; gas, steam, hydroelectric, electric railway and hydraulic work; shop experience; A-1 mechanic and draughtsman; Western location preferred; engaged till Jan. 15; references. Address No. 8012, care of Electrical World, 1570 Old Colony Bldg., Chicago, Ill.

SALESMAN—A hustler with experience desires position; will start right with good company; thorough knowledge of D. C. motors and generators and D. C. apparatus in general; fair knowledge of A. C. apparatus; expert on street railway supplies, insulation of all kinds, insulators, etc. Address No. 8011, care of Electrical World, New York.

YOUNG MAN; 5 years with the General Electric Company in shops, testing, drafting and commercial departments, with a few hundred dollars, wishes to become active partner in some small, established manufacturing concern. Address Box 8006, Electrical World, New York.

ILLUMINATING ENGINEER, college education, with considerable experience in lighting and commercial work, familiar with modern illuminants and distributing systems; at present in charge of illuminating engineering department of central station, desires change to similar position in city of 100,000 or more population. Address No. 8002, Electrical World, N. Y.

POSITIONS VACANT

The rate for "Positions Vacant" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each; payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 1570 Old Colony Building, Chicago, as advertisers may desire.

CENTRAL STATION in a 350,000 town, requires the services of two experienced salesmen who have had experience in selling current for power purposes; only technically trained men with practical experience, who are now, or have been, lately soliciting for a central station need apply, giving full particulars, including salary desired; send photograph if possible, with reply; strong aggressive men, who do not fear and are able to meet competition are wanted. Address Box 8017, care of Electrical World, New York.

WANTED—Salesman to call on electrical manufacturers in East, with headquarters in New York city; desire man with electrical experience or young man with some technical education and good address. Address No. 8018, care of Electrical World, New York.

A LARGE manufacturing concern has need of energetic men of experience in the electrical field for positions as local sales managers in important distributing centers for insulated wires and cables; an unusual opportunity is offered for combined ambition and perseverance in a line of manufacturing, the future of which is practically unlimited. Address Box No. 8014, care of Electrical World, New York.

WANTED—Incandescent lamp salesmen, must have had experience selling lamps or electrical supplies; in reply state age, married or single, salary expected and experience in detail. Address No. 8015, care of Electrical World, New York.

AMERICAN SERVICE COMPANY, Bessemer Building, Pittsburg, require at once hydroelectric engineer-draughtsman (3); electrical switch and signal draughtsman (4); mining installation mechanical electrical superintendent; mining machinery draughtsmen; special track designer; gas-magneto designer-tester-assembler; steel car designer.

DESIGNER—On direct-current motors and generators, must be capable of taking charge and able to design special requirements in the way of windings on standard frames, interpole motors, etc., without guess work or experimenting; only experienced men need apply, giving full particulars and salary required to Box 8004, care of Electrical World, New York.

METER MEN—Wanted men interested in meter and instrument work to take up the course on "Electrical Measuring Instruments and Meters," as prepared by the Fort Wayne Correspondence School, Fort Wayne, Ind. Write for catalog giving information on meter testing.

RESIDENT AGENTS and salesmen in cities and industrial centers on commission basis wanted by manufacturers of complete lines of incandescent lamps. Address No. 7538, care of Electrical World, New York.

ELECTRICIAN and a watch engineer—Wanted an electrician by an American Company in the City of Panama; one who is experienced in maintaining an overhead distribution system; 3-phase, 2300-volts and in maintaining electrical apparatus in power stations of 900 kw capacity; man preferred who is familiar with interior house installation work.

Also wanted a watch engineer for the power house of the same company; one who is familiar with operating electrical and refrigerating apparatus.

Company pays expenses to Panama. Give in both instances experience, references and salaries expected. Address No. 7992, care of Electrical World, New York.

A LARGE independent manufacturer of electrical machinery wants resident agent in the south; prefer an experienced man, thoroughly understanding the business, and who will devote the major portion of his time to the interests of the company; besides making a standard and special line of machinery, we own several patented systems extensively used on which there is practically no competition; exclusive territory; commission basis. Address No. 7991, care of Electrical World, New York.

WANTED—Electrical engineer with commercial training and industrial engineering experience, to take responsible position with large power company as chief power salesman; must be competent to lay out electrical drives and distribution in factories; state age; full details of experience and salary expected. Address Smith, Kerry & Chace, Toronto, Canada.

AMBITIOUS young man, experienced in building motors, can associate himself with a growing Chicago concern making electrical specialties, desiring to add a motor department; must have thorough knowledge; be a practical mechanic and capable of taking complete charge of factory ultimately; a man who qualifies will be given an opportunity to become financially interested; give full particulars, experience, present employment, salary, etc., which will be treated strictly confidential. Address No. 7986, care of Electrical World, New York.

WANTED—Experienced man for testing and repairing electric meters. Apply The Saratoga Gas, Electric Light and Power Company, Saratoga Springs, N. Y.

WANTED—For responsible position as designing engineer; technical graduate, having had six to ten years' experience in design, construction and operation of electrical end of large high voltage systems and local distribution; state age, full details of experience and salary expected. Address Smith, Kerry & Chace, Toronto, Canada.

WANTED—Practical foreman for arc lamp department in Middle West; give experience and wages expected. Address No. 8009, care of Electrical World, New York.

(*Continued on page 78.*)

BOND ISSUES

When money is needed for extension or acquisition of further property, we can furnish the necessary capital.

We sell electric lighting and railway properties, and developed and undeveloped Western Hydro-Electric enterprises.

McGRATH & NEUHAUSEN CO.
Lewis Building
PORTLAND, OREGON

SPARKING

reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire.
All of this may be avoided if you use

The only article that will prevent sparking. Will keep the commutator in good condition and prevent cutting.
Absolutely will not gum the brushes.

It will put that high gloss on the commutator you have so long sought after

Send for Stick 50c. PER STICK $5.00 PER DOZ.

For Sale by All Supply Houses or **K. McLENNAN & CO.** Sole Manufacturers
Room 411—130 Dearborn St., CHICAGO

DEPOSITORY OF THE UNITED STATES, STATE OF NEW YORK, CITY OF NEW YORK

THE COAL & IRON NATIONAL BANK

NEW YORK, 143 Liberty Street

EXCEPTIONAL FACILITIES FOR OUT OF TOWN ACCOUNTS

3

We Finance Extensions and Improvements

to Electric Light, Power and Street Railway properties which have established earnings. If prevented from improving or extending your plant because no more bonds can be issued or sold, or for any other reason, correspond with us.

Electric Bond and Share Company

(Paid-up Capital and Surplus, $4,900,000)
71 Broadway, New York

Dealers in Proven Electric Light, Power and Street Railway Bonds and Stocks.

CARD INDEX ELECTRICAL WORLD, DECEMBER 22, 1910 VOL. LVI.

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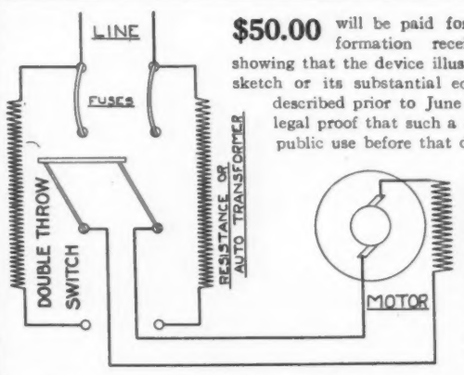


$50.00 will be paid for the first information received by us showing that the device illustrated in the sketch or its substantial equivalent was described prior to June 1st, 1902, or legal proof that such a device was in public use before that date.

If you know of this or a similar device being used or described it will be greatly to your advantage to let us know at once.

THE LINCOLN ELECTRIC CO., Cleveland, O.

COMMONWEALTH EDISON CO.

REPAIR SHOPS

76 MARKET ST., CHICAGO. TELEPHONE RANDOLPH 1280.

FIRST-CLASS EQUIPMENT THROUGHOUT

DYNAMOS, ARMATURES, MOTORS, ARC LAMPS, INSTRUMENTS, HIGH GRADE MACHINE WORK OF ALL KINDS

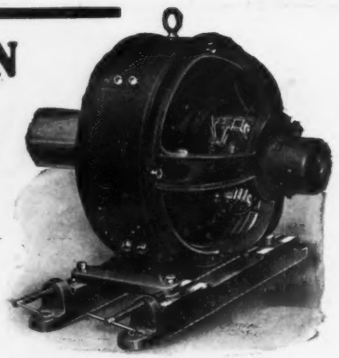
CORRESPONDENCE SOLICITED

LINCOLN

D. C. MOTORS

Made with steel frame bolted laminated pole pieces. Latest design, absolute reliability. As shown and also engine type from 75 to 150 k.w.

Write for bulletins.



Lincoln Electric Co.

Kelley Ave. & E. 36th St.

Cleveland, O.

Write to the nearest Representative

Lincoln Electric Co., Lynn, Mass., Y. M. C. A. Bldg. Muench Brothers, 90 West Street, New York City; Buffalo Electric Co., 87 W. Mohawk St., Buffalo N Y.; Crescent Electric Co., 24th St. & Spring Alley, Pittsburg, Pa.; Maton & Mitchell, Waterbury Conn.; Central Electric Co., 564 Fifth Ave., Chicago, Ill.; E. Stock, 1011 Chestnut St., Phila., Pa.

LIGHT PLANT TO BE SOLD AT

Receivers' Sale:—

I am authorized to sell at Private Sale the grounds, buildings, equipment, franchises and contracts, or the grounds, buildings, franchises and contracts, or the equipment of the City Light and Power Co. at Sebring, Ohio, for ⅔ of appraised value. Bids will be received during next 30 days R. J. JONES, Receiver.

Sebring, O., Dec. 17, 1910.

We Offer for the Commonwealth Edison Co.

1—250 K.V.A., 3-phase, 60-cycle, 240-440-volt, revolving field Crocker-Wheeler Generator and direct connected 16 and 24 x 18 tandem compound side crank Skinner automatic engine, 200 R.P.M.; complete switchboard equipment and all usual engine and generator accessories.

This unit is brand new; still at the factory. It is offered for sale on account of the installation of Edison service in plant for which it was built. Price on application.

POWER EQUIPMENT CO., Fisher Bldg., Chicago

Want Advertisements Bring Results

"It may please you to know that I got the position of Superintendent of this company through an advertisement that I inserted in the ELECTRICAL WORLD."

FOR SALE

Induction Motors Forty cycle Three phase General Electric 220 volts with accessories used few months. Conditions guaranteed.

Three seventeen H. P. twelve hundred K.

One eight H. P. eight hundred K.

WILLIAM BRADLEY & SON

547 Vernon Avenue, Long Island City, N. Y.

POSITIONS VACANT

(Continued from page 76.)

WANTED—Electrical engineer for laboratory of factory of special electrical apparatus; must be perfectly familiar with meters and transformers and be good draftsman; those with experience on electric arc lamps preferred; permanent position for right man; write fully, giving experience, references, salary expected and age. Address No. 8007, care of Electrical World, New York.

WANTED—A graduate electrical engineer as instructor of electrical engineering; position open at once; further particulars upon request. Address No. 8005, care of Electrical World, New York.

BY ASKING FRIENDS for inventors' addresses and soliciting patent business for undersigned, you retain 15% commission and have technical homework; preserve this agreement. First step, mail inventions for estimate, free opinion, etc. Edward P. Thompson, M.E., the only registered patent attorney who is a member of both American Institute Electrical Engineers and American Society of Mechanical Engineers. Established 20 years. 34 E. 32d St., N. Y. Victor Bldg., Washington, D. C.

EDUCATIONAL

The rate for "Educational" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words, three cents each; payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

RENSSELAER POLYTECHNIC INSTITUTE, Troy, N. Y.—Courses in Civil, Mechanical and Electrical Engineering and General Sciences, leading to the degree of Civil Engineer (C. E.), Mechanical Engineer (M. E.), Electrical Engineer (E. E.) and Bachelor of Sciences (B. S.) Special courses in Engineering and Sciences. Splendidly equipped new engineering laboratories. Send for catalogues to the Registrar.

MISCELLANEOUS

The rate for "Miscellaneous" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words, three cents each; payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

FOR SALE—Electric light plant at a big bargain; located in prosperous Indiana town; approximately 1500 inhabitants; in fine operative condition and a good money maker. Write for particulars. Address No. 7512, care of Electrical World, New York.

NEW 9-room house, all improvements, small electric supply factory in rear, several thousand dollars contract, too, if desired; electric and water power; chance of a lifetime for making small articles; select neighborhood; owner going West; $7,000; $3,000 mortgage. Cress & Plum, 320 Market St., Newark, N. J.

WANTED—We pay highest prices for discarded dynamo belts. Write us, Atlantic Mill Supply Co., Wilmington, Del.

FOR SALE—An electric light and power plant, with ten (10) ton York ice plant in connection therewith, in a rapidly growing West Virginia town of about 4500 population; day and night service; city lighting contract; good power load during the day; no gas or other competition; cheap fuel; coal at 80 cents per ton delivered at the plant.

Bond issue representing partial cost of plant and equipment, running for 18 years, interest 6 per cent.

Now paying all fixed charges and with fair profit to stockholders. Total output ice plant contracted for yearly $3.65 per ton at plant. Ice and lighting plants in first-class condition.

Practically no current indebtedness.

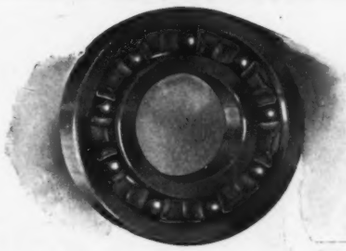
A practical man can get a bargain and full particulars will be furnished. Parties now owning it are bankers and lawyers, with no time to give to the business and little knowledge of it. Apply Box 27, Philippi, W. Va.

HALF interest in established manufacturer's agency handling light and power supplies, for sale; now on basis of $3,000 per year; services more than cash required, and this should not be considered by those who cannot get in and assume half the work; extreme Western city. Address No. 8008, care of Electrical World, New York.

PROPOSALS

PROPOSALS TO FURNISH MACHINES, motors, and limit switches to operate the Stoney Gate Valves and Cylindrical Valves for Controlling the Culverts of the Locks at Gatun, Pedro Miguel and Miraflores.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until 10:30 a.m., February 25, 1911, at which time they will be opened in public, for furnishing the above-mentioned articles. Blanks and general information relating to this Circular (No. 614) may be obtained from this office or the offices of the Assistant Purchasing Agents, 24 State Street, New York City; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal., also from the U. S. Engineer Offices in the following cities: Seattle, Wash.; Los Angeles, Cal.; Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky.; Mobile, Ala., and Galveston, Tex.; Commercial Club Kansas City, Mo.; Chamber of Commerce, Quincy, Ill., and Chamber of Commerce Tacoma, Wash.—F. C. BOGGS, Captain, Corps of Engineers, U.S.A., a. Purchasing Officer.

TREASURY DEPARTMENT, WASHINGton, D. C., Office of Supervising Architect, December 19, 1910.—Sealed proposals will be received at this office until 3 o'clock p.m., Friday, January 20, 1911, and then opened, for supplying and installing lighting fixtures in the U. S. buildings at Goldsboro, N. C., Henderson, N. C.; Council Bluffs, Iowa; Danville, Ill.; Jackson, Tenn., and Sioux City, Iowa, in strict accordance with the drawings and specifications, copies of which may be obtained at this office at the discretion of the Supervising Architect. The right is reserved to reject any and all proposals and to waive defects. Each proposal must be accompanied by a certified check, drawn to the order of the Treasurer of the United States in the sum of two per cent of the aggregate amount thereof, as a guarantee of good faith. The proposals should be addressed to the Supervising Architect, Treasury Department, Washington, D. C., and the envelope endorsed "Proposal for lighting fixtures for U. S. buildings at Goldsboro, N. C.; Henderson, N. C.; Council Bluffs, Iowa; Danville, Ills.; Jackson, Tenn. and Sioux City, Iowa." J. K. TAYLOR, Supervising Architect.



REDUCED CURRENT CONSUMPTION

is invariably one result when motors are equipped with

Hess-Bright Ball Bearings

Some of the others are:
Constant Air-gap
Always good Commutation
Greatly reduced repair bills.

Our catalog and data sheets are full of useful information.

Shall we send them?

The Hess-Bright Mfg. Co. 2112 Fairmount Avenue Philadelphia

OUR MULTI-SPEED ELECTRIC MOTORS

are of the MULTI-POLAR form, from 5 H.P. up

ESTABLISHED 1875

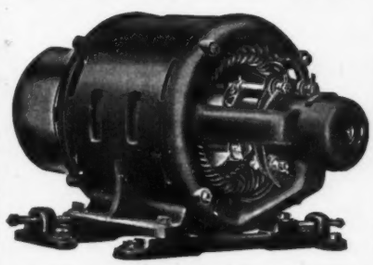
We call them MULTI-SPEED because speed changes are not made by steps, but an absolutely unbroken range is furnished between the highest and lowest points—in other words, every imaginable speed is given within these limits.

They will carry full load at all speeds within their range without sparking, with an efficiency practically as high at one speed as another. These results are arrived at without the use of rheostats or controllers. Let us mail you further details.

STOW MFG. CO., Binghamton, N. Y.

General European Agents:
SELIG, SONENTHAL & CO., Queen Victoria St., London, Eng.

RICHMOND



VARIABLE SPEED POLYPHASE MOTORS

¼ to 100 H.P.

The Richmond Electric Company
Richmond, Va.

JORDAN COMMUTATOR TRUING DEVICE

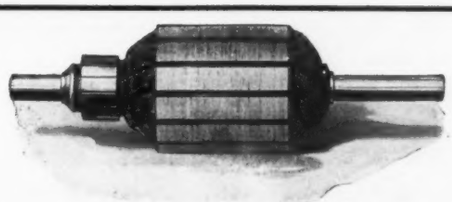
This device will true your commutator without removing the armature; easy to attach and operate. Does not take large cuts, which shorten the life of a commutator; no dragging of copper across the insulation between the bars, thereby short circuiting the same, and will soon pay for itself. This type device can very readily be attached to dynamos or motors and is especially intended for machines having small diameter commutator or collector ring. Silver Medal Award, Jamestown Exposition. Write for catalog No. 3, with list of users, prices, etc.

Patented April 16, 1898, and May 16, 1905; other patents pending.

MANUFACTURED BY

Front View of Type J Commutator Truing Device attached to Crocker-Wheeler Motor.

JORDAN BROTHERS, Inc., 74 Beekman Street, N. Y. City



YOU CAN BANK ON
steady motor use if you'll make your standard

PEERLESS INDIVIDUAL DRIVES

Troubles are few and far between. They are the Central Station's Dependable income producer.
1/30 to 30 H. P. Direct Current. Write for "Peerless Drives".

THE PEERLESS ELECTRIC COMPANY
Factory and Main Office: WARREN, OHIO 4
CHICAGO: 46 Van Buren St. New York: 43 West 27th St.

Watson Multipolar Motors

(DIRECT DRIVE)

Save their cost in power, time and labor in a few months and keep on saving.

Tell us your present power costs, your equipment and your output. We will show you in cold figures, backed by the experience of others, how you decrease your costs, increase your output, and improve your working facilities.

Mechanical Appliance Co., Milwaukee, Wis.

This or This

What power are manufacturers in your locality using? If it is other than electric you are neglecting your opportunities.

Electric power is always ready—it can be started or stopped almost instantly.

No matter what these manufacturers use power for, or how much of it they use—from the smallest machine to the largest factory—induce them to install and try a

Fort Wayne Electric Motor

The amount they will save—not to mention the convenience—will decide their future power problem.

All the power they pay for then, is delivered directly to the machine—they don't lose 30% to 50% on flapping belts, line shafts or pulleys.

Motors need no firemen or engineer—only an occasional oiling—and they supply each tool with just the right power and speed to secure its maximum output.

We make motors of all sizes from 1/100 horsepower up and can furnish the kind especially suited to any particular need.

Our bulletin "Motor Drives" (sent free on request) explains and illustrates some 40 of their applications. Send for it today.

FORT WAYNE ELECTRIC WORKS

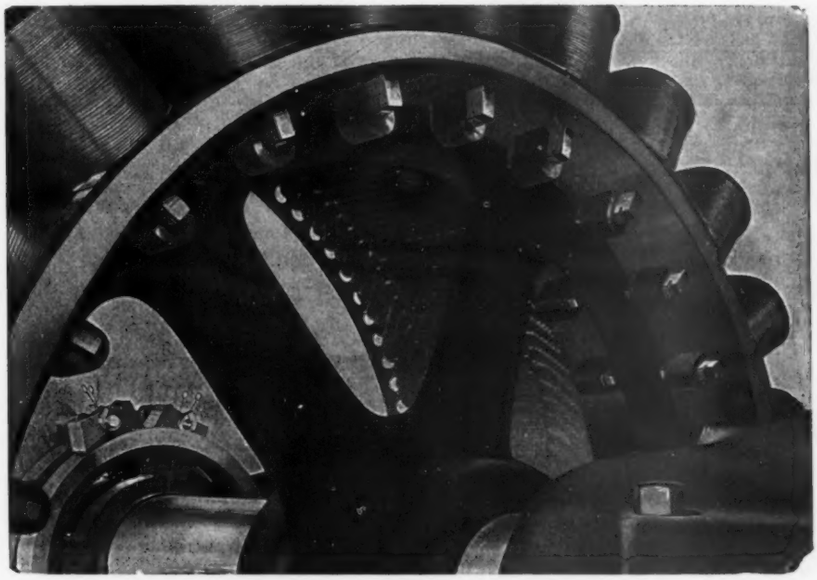
"Wood" Sytems

1609 BROADWAY FORT WAYNE, IND.

Branch Offices: Most Large Cities

ELECTRIC MACHINERY CO.

MINNEAPOLIS
MINNESOTA



Our Alternators are Popular

The cut shows our PATENTED revolving field and POLE ANCHOR.

No bolts, screws or nuts, no possibility of flaws in parts under stress. As simple as a crowbar. Absolutely safe at runaway speed. All other features as carefully designed.

WRITE FOR BULLETINS.

They describe all other features of our remarkably successful alternators.

All sizes—30 to 1000 KW.

WRITE TODAY.

THE DEMAND FOR
CENTURY SINGLE PHASE MOTORS
increased during the year 1910 almost

100%

over the previous year.

which indicates that not only are our claims of superiority borne out in practice, but that single phase motors are becoming more popular with central station managers.

¼ to 40 Horse Power, 25 to 140 Cycles.

Century Electric Co.

New York Office:
Hudson Terminal
30 Church Street

Main Office and Works:
19th & Olive Sts.
St. Louis, Mo.

Municipal Lighting Plants Are Safe

C-W REMEK *Lighting Transformers*

in contracting for **REMEK** transformers. The value of using these novel, highly efficient machines is *easily proved*. Our Bulletin 125-O is a most important chapter in the history of transformer design.

CROCKER-WHEELER COMPANY

A. C. and D. C. Machinery

Baltimore, Birmingham, Boston, Chicago, Cleveland, Denver, Detroit, Newark, New Haven, New York, Philadelphia, Pittsburg, Syracuse, Ampere, N. J., etc.

A YEAR OF PROGRESS

The McGraw-Hill Book Company gives below the titles of the 45 books which they have published in 1910. It has been a year of rapid growth along the lines laid down at the time this company was organized—**better engineering books in both text and manufacture.**

We urge your careful examination of the list. We emphasize the wide range of subjects, the importance of the men who have contributed, and the high standard of the books.

Yet this is but a start. During the coming year we shall publish a great many most important technical books—another long step, we hope, toward the ideal.

Complete descriptive circulars and classified catalogues upon request.

Chemistry

Municipal Chemistry

Edited by Charles Baskerville, Ph.D., F. C. S., Professor of Chemistry and Director of the Laboratory, College of the City of N. Y.
530 pages, 6x9, illustrated, $5.00. (21s.)

The Analysis of Paints and Painting Materials

By Henry A. Gardner and John A. Schaeffer, 96 pages, 6x9, illustrated, $1.50. (6/6.)

Mining and Metallurgy

Principles of Metallurgy

By Charles H. Fulton, President and Professor of Metallurgy, South Dakota School of Mines, 536 pages, 6x9, illustrated, $5.00. (21s.)

Mineral Industry

Volume XVIII—1909, edited by Walter Renton Ingalls, 900 pages, illustrated, $10. (42s.)

Cyanide Handbook

By J. E. Clennell, 526 pages, 6x9, illustrated, $5.00. (21s.)

Chemistry of Cyanide Solutions

By J. E. Clennell, 198 pages, 6x9, illustrated, $2.50. (10/6.)

Elementary Crystallography

By W. S. Bayley, Ph.D., Associate Professor of Mineralogy and Economic Geology, University of Illinois, 236 pages, 6x9, illustrated, $2.00. (8/6.)

Practical Data for the Cyanide Plant

By Herbert A. Megraw, 93 pages, Leather, pocket size, illustrated, $2.00. (8/6.)

Iron and Steel

Composition and Heat Treatment of Steel

By E. F. Lake, Steel Editor of the "American Machinist," 246 pages, 6x9, illustrated, $2.50. (10/6.)

High Speed Steel

By O. M. Becker, 360 pages, 6x9, illustrated, $4.00. (17s.)

Mechanical Engineering

See also Iron and Steel

Hydraulic Turbines

Their Design and Installation, translated from the revised German text by Viktor Gelpke, by A. H. Van Cleve, 300 pages, 7x9, illustrated, $4.00. (17s.)

Heat Engines

Steam, Gas, Steam Turbines. Auxiliaries. By John R. Allen and Joseph A. Bursley, Professors of Mechanical Engineering, Univ. of Mich, 288 pages, 6x9, illustrated, $3.00. (12/6.)

Hydraulic Elevators

By William Baxter, Jr., 300 pages, 6x9, illustrated, $2.50. (10/6.)

The Steam Engine Indicator

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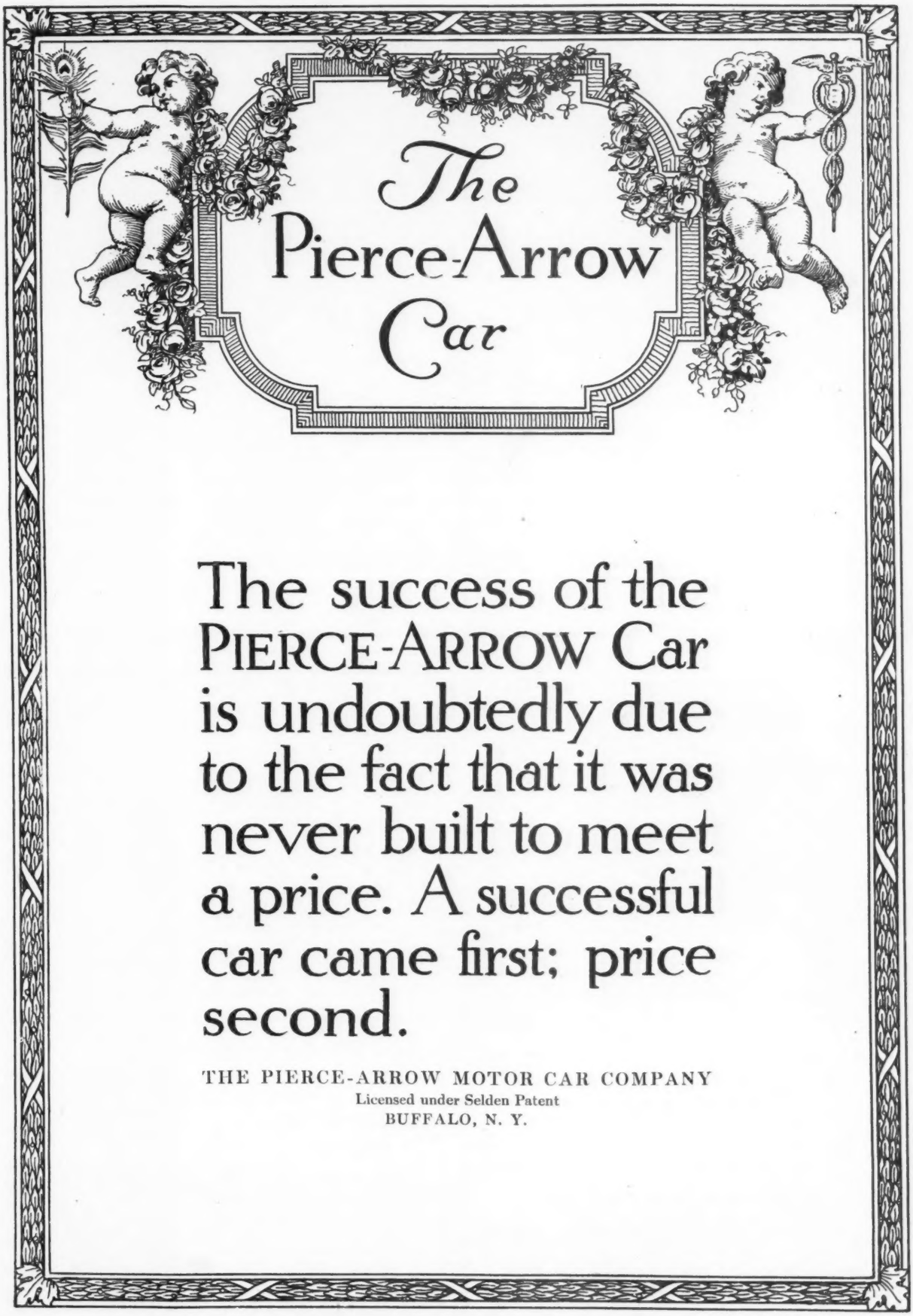
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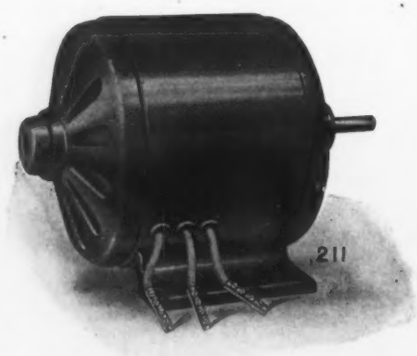

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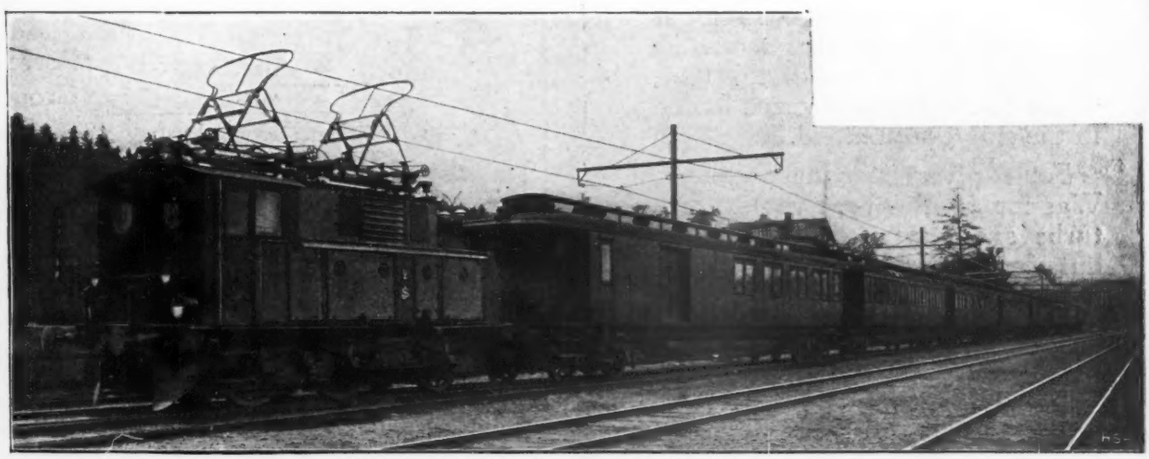

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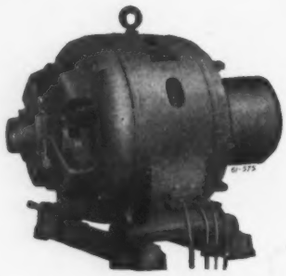

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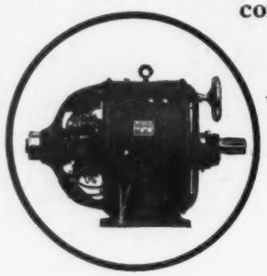

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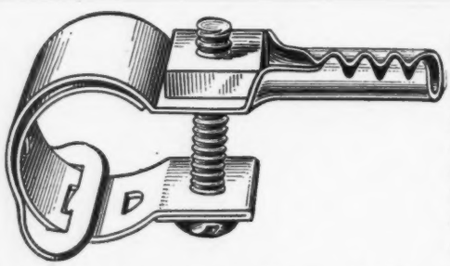

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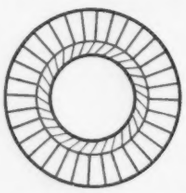

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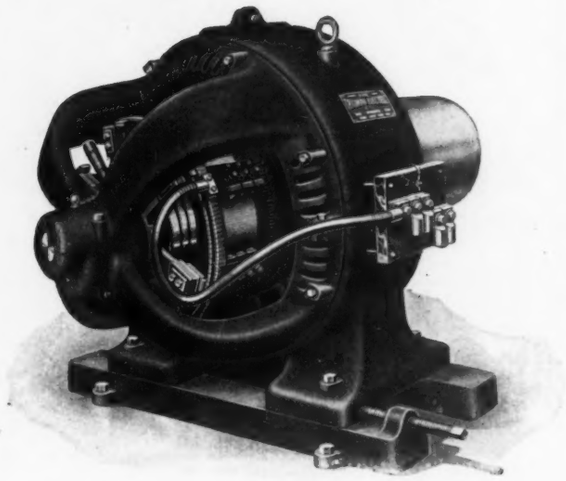

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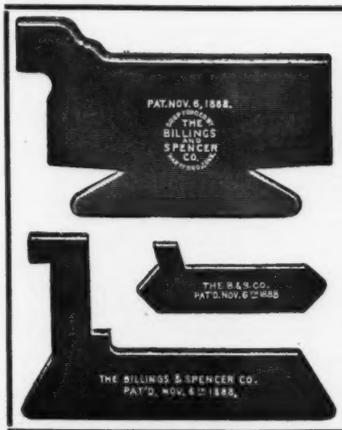

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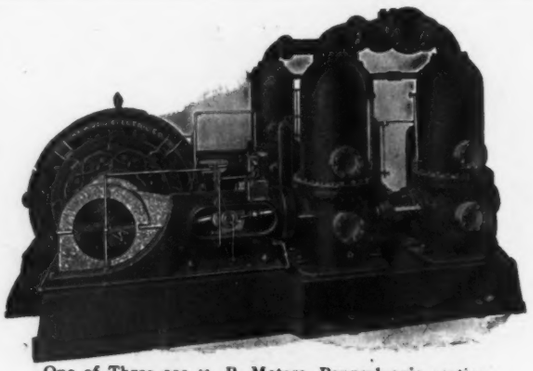

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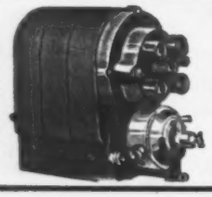

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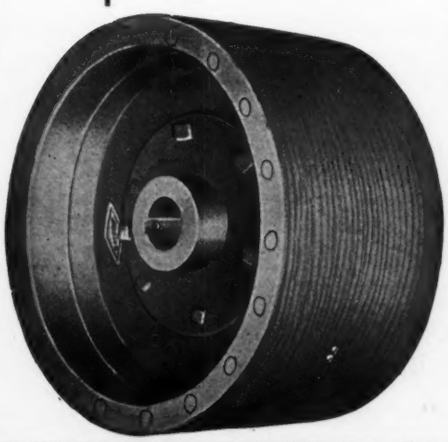

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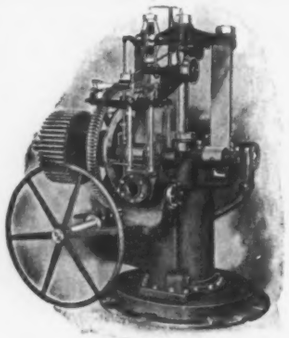

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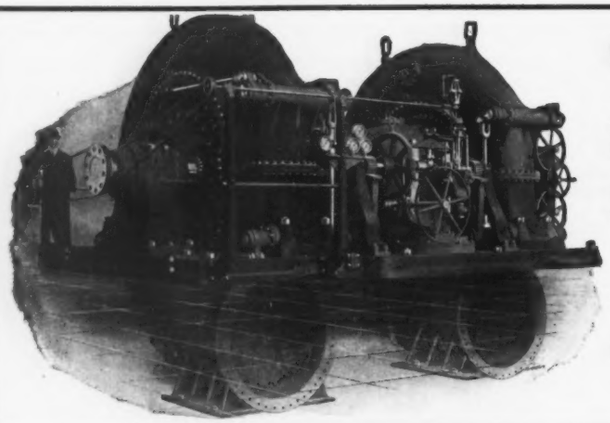

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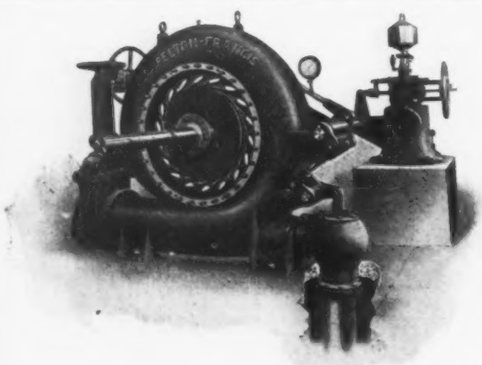

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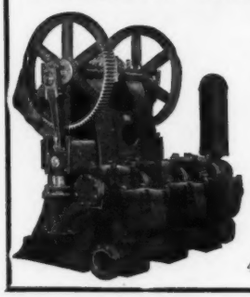

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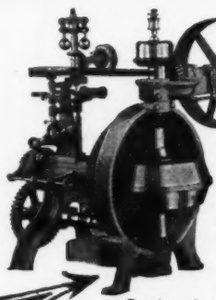

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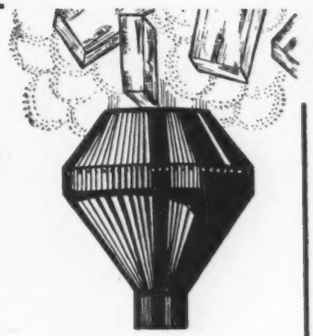

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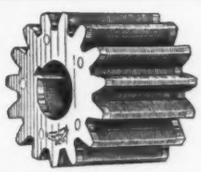
for motor and other high speed drives.
See our large advertisement in first and third issues of the month.



The New Process Raw Hide Co.,
500 Plum St., Syracuse, N. Y.

Peak Loads Are Not So Heavy

on the boiler plant if the Cyclone Tube Cleaner is used to remove the scale. A trial on your own boilers at our expense, if you say so. Write!

LIBERTY MFG. CO.
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Deming Pumps
For All Uses and Any Power

Triplex Power Pumps
Ask for Catalog "G"

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New American Turbines
In Vertical or Horizontal, Single or Multi-Wheel Units

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Catalog 12-R on application.

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All styles and designs built to suit your location.
Send at once for our illustrated catalog.

THE TRUMP MFG. COMPANY
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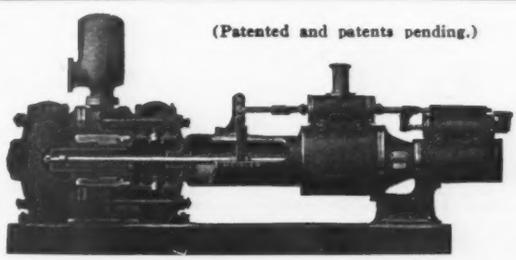
(Patented and patents pending.)



HEISLER PRESSURE AND BOILER FEED PUMPS

Outside packed direct-acting semi-pot valve type. Sealed plunger packing, all joints tongued. No flat gaskets. Examine that anti-cramping, sealed, plunger packing; those tongued joints, and tie rods connecting the four simple units. There being no drips or leakage, spill trays are not required.

They have been installed in the largest boiler plants of the world. In one plant they pump a total of ten million gallons per day.

The Heisler Company, Jackson Boulevard, St. Marys, Ohio

Morse Chain Exciter Drive

Chain Facts

I

The Morse Silent Chain

unlike all other chains does not wear at the joints.

II

The Morse Silent Chain

has a sustained efficiency of nearly 99 per cent, thus makeing it one of the most economical power transmitters known.

III

The Morse Silent Chain

is equally efficient at either high or low speed.

IV

The Morse Silent Chain

can be successfully run on sprockets as small as 13 and as large as 130 teeth.

V

The Morse Silent Chain

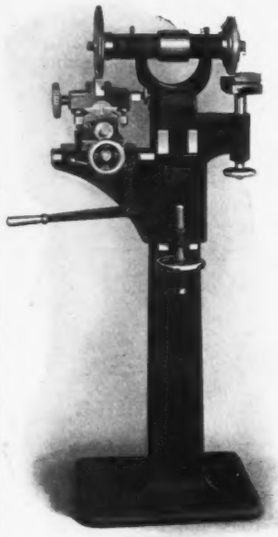
is the chain you should have for any drive ranging from ¼ to 1000 horse power.

See Catalogue No. 9

Morse Chain Co.
ITHACA, NEW YORK

Licensees for Great Britain and Europe, The Westinghouse Brake Co., Ltd., 32 York Road, Kings Cross, London, N.

Geometric Chaser or Die Grinder



Not the cheapest Grinder on the market, but the most economical.

Will grind any make of chaser. Also has a second grinding wheel for ordinary tool grinding.

If you are interested, it will be to your advantage to secure one of these machines now, while the introductory price is on.

A booklet describing this machine will be sent you on request.

The Geometric Tool Company
New Haven, Conn. 2

IT DOES NOT TAKE A PAGE TO TELL OF

CARPENTER'S
Machine Screw Taps

Oldest on the market. None superior. That's all.

TRADE MARK

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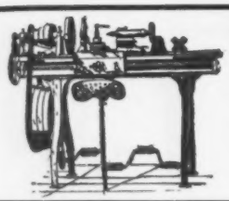
We are prepared to furnish Machine Screw Taps and Dies to the New Standard adopted by the American Society of Mechanical Engineers.

THE J. M. CARPENTER TAP AND DIE CO.
PAWTUCKET, R. I., U. S. A.



LATHES 9 to 13 Inch Swing for Foot or Steam Power.

No. 4½	Lathe,	9 x 25.... List	$75.00
No. 5	"	11 x 34.... "	100.00
No. 5½	"	13 x 33.... "	135.00
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The No. 13 Lathe has automatic cross feed and compound rest. Beds made 5 to 10 feet long.

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BEING 60 PER CENT. PURE GRAPHITE INSURES LOW RESISTANCE, NO SPARKING UNDER VARYING LOAD, LONGER WEAR AND NO GREASING.

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GERMANTOWN, PHILADELPHIA, PA.

Increased Income without Increased Peak Load

That's the surety that stares you in the face. You can sell exhaust steam for heating purposes, derive a good sized profit and a sure one but without increasing your load or interfering in any way with the present use of exhaust steam for auxiliary purposes in your plant. The

American District Steam Heating System

has reduced the proposition of selling exhaust steam to a commercial basis. Method and mechanical detail have been developed to perfection. As an example :

One plant in which the cost of fuel, water and boiler-house labor during eighteen heating months amounted to $40,971.17 derived an income of $60,721.92 during that time from the sale of exhaust steam for heating by the American District Steam Heating System.

We are ready to send an engineer to figure with you, without expense or obligation on your part. Bulletins, catalogs, etc., await a sign of interest from you.

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Why OTTO Products are Cheapest

WHAT OUR SUCCESS MEANS TO YOU!

Some Successes

are of the brass band variety. Some of them spring up much like fungus that rises over night, only to wither with the first sun.

But the success of the Otto has been different, for 34 years now we've been building, working out a consistent, steady growth.

In 1876 the Otto was the *only* practical gas engine, and year after year since that time has the Otto forged ahead, each year seeing its improvements and resultant growth of business and reputation.

To-day, with over 100,000 Otto engines and over 11,000 Otto Suction Gas Producers in successful operation, the Otto Gas Engine Works, with seven factories in various countries, is the oldest and most successful company in the world manufacturing gas and gasoline engines.

Now the significance of this to you is—

The Otto Company could not possibly have attained a degree of success beyond all others if the Otto *products* had not also been superior to all other gas and gasoline engines.

And, as noted before, it is of still further significance that this success is entirely due to the merits of the Otto products, we having never resorted to "brass band" methods.

Now, if you are more interested in *past accomplishments* than *present claims* we want to tell you more about Otto products.

That's why the coupon is attached, so that you can drop us your name and address by tearing it out signing and mailing it to us.

Please do this now.

THE OTTO GAS ENGINE WORKS, 3207 Walnut Street, PHILADELPHIA, PA.

Branches—Chicago, Boston, New York, Pittsburg, Omaha, Kansas City, Minneapolis, San Francisco.

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Gentlemen:—Replying to your ad. in Electrical World, Dec., send me catalogues, etc., together with approximate for installing Otto Suction Gas Producer Plant of .....
H. P.
Name .....
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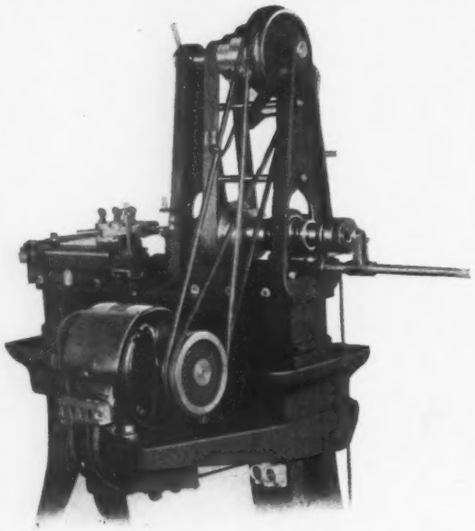

GARVIN No. 1 Screw Machine
Motor Driven

Remember, when fitting up your shop with machine tools, that the most economical and best way of driving the machines is by an individual motor. You save about 20% to 40% of your power, and you have a machine that can be placed in any position or place in the shop at any time. No countershafts or belts leading from same to shut off light and give trouble. Motor drive, as applied to a GARVIN No. 1 Screw Machine, is the cleanest proposition on the market. The machine is simple, durable and easily adjusted. Has many desirable qualities and practical advantages. SEVEN OTHER SIZES.

DIMENSIONS.

Capacity of spindle with wire feed	5/8 in.
Length that can be turned	3 in.
Swing over bed	9 in.
Number of holes in turret	6
Width of belt required	2 in.
Floor space required	42 x 22 in.
Weight (crated)	575 lbs.

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Sizes up to TROY, N. Y. 60,000 Ft. Lbs.

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REMOVE BOILER SCALE THE THOROUGH DEARBORN WAY

Dearborn Treatment destroys the incrusting agents in the water, and there will be no accumulation of scale in those places where a coating of scale is so dangerous, and which cannot be reached for cleaning by mechanical means.

Use Dearborn Treatment and avoid the danger element, save fuel and repairs.

Gallon sample required for analysis.

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With Dixon's Graphite Brushes you avoid excessive wear on the commutator.

Graphite being a lubricant prevents wear on your commutator as well as reducing losses due to friction.

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Ablest Engineering Organization in the Blower Business—Operating three large plants devoted exclusively to the manufacture of Fan System Apparatus and Allied Lines.

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Peerless Piston and Valve Rod Packing

will hold 400 pounds steam. Will run twelve months in high-speed engines. Made round and square. Put up in coils, spiral and ring form. In sizes from one-quarter to two inches.

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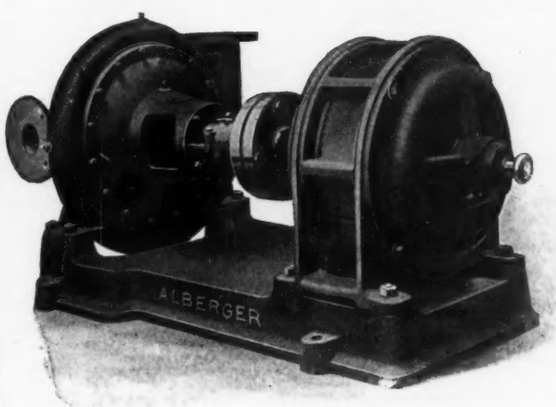

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for

Any Head
Any Quantity
Any Drive

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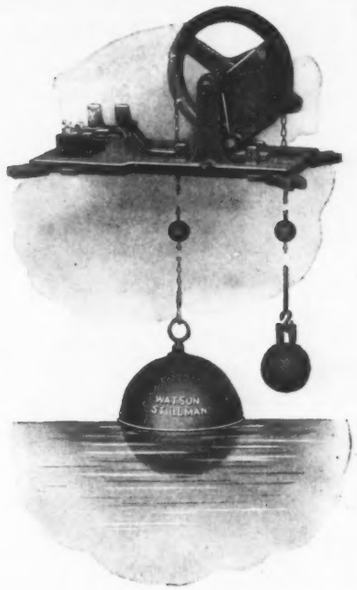

Automatically-controlled Twinvolute Turbine Pumps for Water Supply or Sump Drainage

The combination of a motor-driven Twinvolute Pump with Watson-Stillman Automatic Tank Switch is ideal for automatically maintaining the water level between fixed limits in any tank or sump. The switch in the tank (shown above) starts the pump motor when the water gets low and stops it as the level approaches the desired height and vice-versa for sump work.

No other pump than the Watson-Stillman Twinvolute requires so little attention and repairs and makes so little noise in this service. The saving of space and power here as elsewhere is a notable feature of Twinvolute Pumps for the twinvolute water way (patented) does away with the errors of unequal work, pressure, velocity and objectionable eddies.

Twinvolute pumps are made for any volume, any pressure and any pumping service,—water supply, fire, boiler feed, circulating condenser water, etc. Tell us your requirements and ask for Catalog No. 75.

THE WATSON-STILLMAN CO.

52 Church Street **New York**

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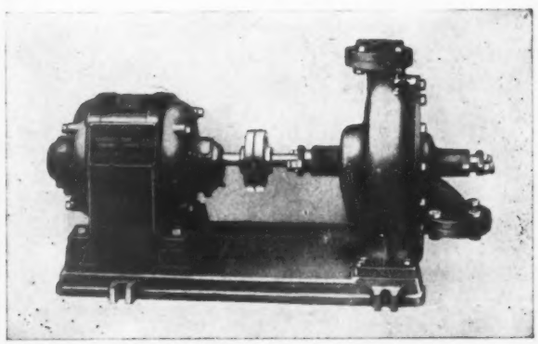

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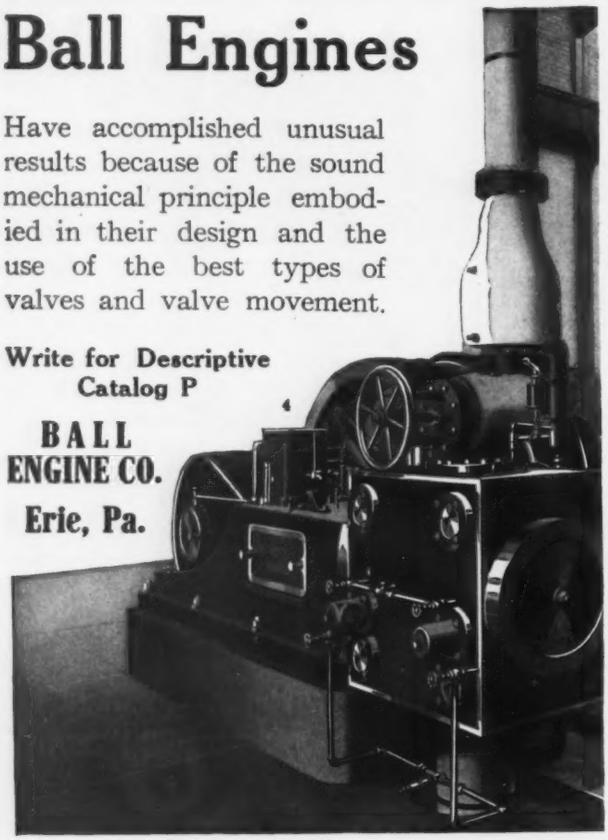
Have accomplished unusual results because of the sound mechanical principle embodied in their design and the use of the best types of valves and valve movement.



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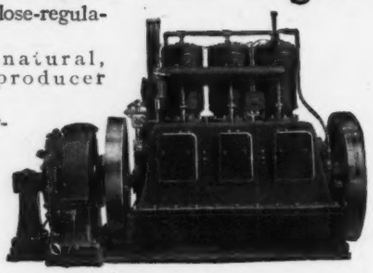
Erie, Pa.

Turner-Fricke Gas Engine

A high-grade, close-regulating engine

Operating on natural, illuminating or producer gas.

Absolutely guaranteed in regard to operation, workmanship and material.



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Agents wanted everywhere.

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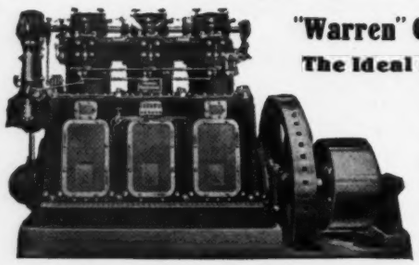

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The Ideal Guaranteed Power for Electric Lighting Plants.

One Brake Horse Power Hour on 10,000 B. T. U., which means 12 cu. ft. of Natural Gas, or One and One-Quarter Pounds of Fuel Gasified in Our Suction Gas Producer. It is so much cheaper than any other, in both operating and fuel costs, that it pays back a handsome interest on the money invested in the installation. Regulation sufficiently close to meet the most severe requirements of Electrical Service.

Manufactured by STRUTHERS-WELLS COMPANY, Warren, Pa.

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"MAXIMUM" Silent Chain

for power-transmission

Write for Book No. 102 "C"

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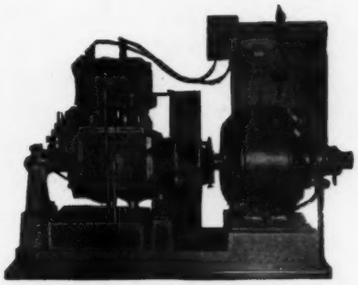

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TEN H. P. Engine, direct-connected to generator. Normal capacity 4 K. W.; maximum 5½ K. W. Weight, as shown in cut, 1350 lbs. Space 2 x 5 ft.

List price complete with tank, switchboard, etc., etc., $800 (subject to discount).

Either 115 or 60 volts; suitable for stores, hotels, moving picture theaters, summer and winter resorts, country homes, etc.

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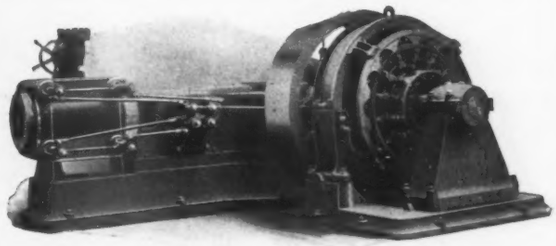

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Engines and Generators

are above all things

RELIABLE

Is there a much better quality to be asked of man, beast or machine?

You want your power when you want it and you will find RIDGWAY apparatus is always ready to serve.

Just drop us a card asking for our Bulletin collection X and then tell us what kind of an outfit you want.

RIDGWAY DYNAMO & ENGINE CO.

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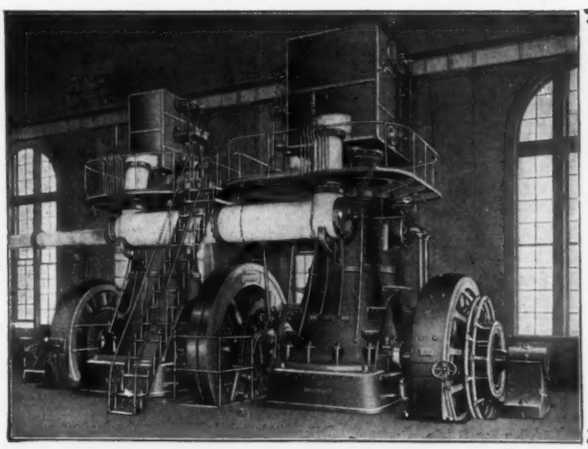

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ENGINES Corliss Valve Non-releasing Gear and Single Valve Automatic Cut-off

Rateau-Smoot Steam Turbines

Low Pressure, Mixed Flow, and High Pressure with Smoot A. C. or D. C. Generators

Steam Pipe and Bends with **WELDED FLANGES**

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Bulletin "EW126"—Drying in Industrial Plants
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THE GREEN FUEL ECONOMIZER CO., MATTEAWAN, N. Y.

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PITTSBURGH VALVE, FOUNDRY & CONSTRUCTION CO.

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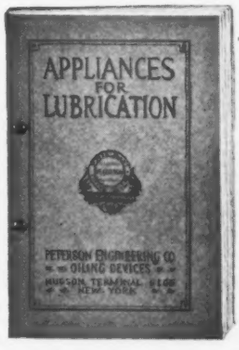

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EVERYTHING FOR APPLYING LUBRICATION

PETERSON ENGINEERING CO.

Hudson Terminal Bldg. New York City — 1st Nat. Bank Bldg. Chicago, Ill.

Cut out this coupon NOW.

Name.....

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Transformer Buyers Should Know These Facts

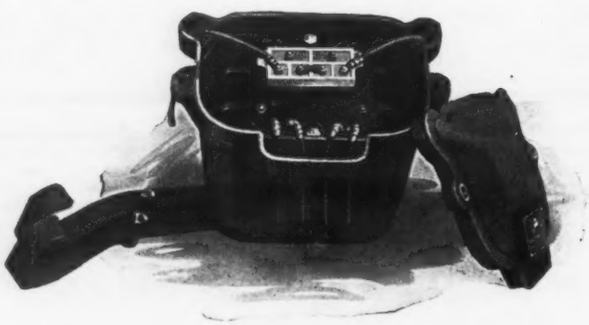
Superior Regulation

Allis-Chalmers transformers are designed so that the regulation is extremely low and uniform. Different size transformers can be used on the same line with the certainty that each will use only its proportionate share of energy.

Extra Ratios

In addition to the usual transformer ratios, 11 additional ratios can be obtained from these transformers by the use of 5 and 10% taps.

The same transformer can be used near the generating station or at distant points



The efficiency regulation and insulation strength are little affected by length of service

The cores of Allis-Chalmers transformers are made of non-ageing steel and have practically the same low core loss at the end of a year's operation as when installed.

Non-Ageing Steel

The coils which are hermetically sealed by impregnation are insulated from one another by fireproof material. This insulation is not affected by either heat, oil or moisture.

Thorough Insulation

Allis-Chalmers Company

DISTRICT OFFICES IN ALL PRINCIPAL CITIES - General Offices, MILWAUKEE, WIS.

The present tendency towards using low-wattage lamps, makes the accuracy of residence meters at light loads of particular importance.

Westinghouse Type "C" Watthour Meters

register within 2 per cent, plus or minus, from 2 per cent of full load to 50 per cent overload. They are furnished sealed or unsealed, whichever best suits the local conditions. With seals intact, the accuracy of the Westinghouse Watthour Meters is guaranteed; with seals broken, they have the usual commercial guarantee.

Circular 1137 gives all particulars.

Westinghouse Electric & Manufacturing Co.

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Baltimore Boston Cincinnati Detroit Los Angeles New York Pittsburg Salt Lake City Seattle
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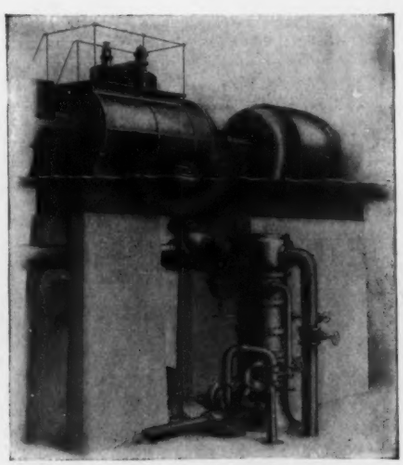
Mexico: Compania Ingeniera, Importadora y Contratista, S. A., successors to G. & O. Braniff & Company, City of Mexico.

The Westinghouse-Leblanc Condenser

occupies only a small fraction of the space formerly allotted to this class of apparatus



Westinghouse-Leblanc Condenser Installed Beneath Steam Turbine.

Compactness is, however, but secondary to its other superior features:—

Through a simple application of rotary motion it develops a higher efficiency than heretofore possible. The duty of separately removing the water and air is performed by a pair of small turbine type rotors on a common shaft in a single unit casing, which is integral with the lower portion of the condensing chamber.

Circular 501 gives all particulars.

The Westinghouse Machine Company

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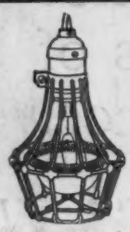

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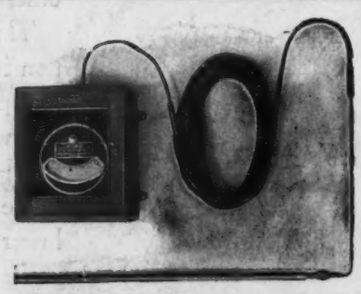

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